PB90-910202

# SELECTED WATER RESOURCES ABSTRACTS

VOLUME 23, NUMBER 2
FEBRUARY 1990

W90-00962 — W90-01943
CODEN: SWRABW

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# SELECTED WATER RESOURCES ABSTRACTS

A monthly publication of the Geological Survey
U.S. Department of the Interior

**VOLUME 23, NUMBER 2**
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The Secretary of the Interior has determined that the publication of this periodical is necessary in the transaction of the public business required by law of this Department. Use of funds for printing this periodical has been approved by the Office of Management and Budget through September 1990.

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. administration.

# PREFACE

**Selected Water Resources Abstracts,** a monthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. These documents cover water resources as treated in the life, physical, and social sciences and the related engineering and legal aspects of the characteristics, supply condition, conservation, control, use, or management of water resources. Each abstract includes a full bibliographic citation and a set of descriptors which are listed in the **Water Resources Thesaurus.** The abstract entries are classified into 10 fields and 60 groups similar to the water resources research categories established by the Committee on Water Resources Research of the then Federal Council for Science and Technology.

**Selected Water Resources Abstracts** is designed to serve the scientific and technical information needs of scientists, engineers, and managers as one of several services of the Water Resources Scientific Information Center. The cumulative SWRA file from 1968 and monthly updates are available also in magnetic tape through lease from NTIS.

THE WATER RESOURCES SCIENTIFIC INFORMATION CENTER DOES NOT PROVIDE COPIES OF DOCUMENTS ABSTRACTED IN THIS JOURNAL. Sufficient bibliographic information is given to enable readers to order the desired documents from local libraries or other sources.

Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Water Resources Scientific
Information Center
U.S. Geological Survey
MS 425 National Center
Reston, VA 22092

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Includes the following Groups: General; Precipitation; Snow, Ice, and Frost; Evaporation and Transpiration; Streamflow and Runoff; Groundwater; Water in Soils; Lakes; Water in Plants; Erosion and Sedimentation; Chemical Processes; Estuaries.

03 WATER SUPPLY AUGMENTATION AND CONSERVATION

Includes the following Groups: Saline Water Conversion; Water Yield Improvement; Use of Water of Impaired Quality; Conservation in Domestic and Municipal Use; Conservation in Industry; Conservation in Agriculture.

04 WATER QUANTITY MANAGEMENT AND CONTROL

Includes the following Groups: Control of Water on the Surface; Groundwater Management; Effects on Water of Man's Nonwater Activities; Watershed Protection.

05 WATER QUALITY MANAGEMENT AND PROTECTION

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06 WATER RESOURCES PLANNING

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07 RESOURCES DATA

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08 ENGINEERING WORKS

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# SELECTED WATER RESOURCES ABSTRACTS

## 2. WATER CYCLE

### 2A. General

**RIVER-GROUNDWATER RELATIONSHIPS IN THE LOWER PARTS OF THE NETHERLANDS.**
Rijksinstituut voor de Volksgezondheid en Milieuhygiene, Bilthoven (Netherlands).
G. J. Heij.
Journal of Hydrology JHYDA7, Vol. 108, No. 1-4, p 35-62, Jun 1989. 18 fig, 9 ref.

Descriptors: *Surface water, *Groundwater, *Aquifers, *Infiltration rate, *Surface-groundwater relations, *Hydraulic permeability, *Geohydrology, Model studies, Mathematical models, The Netherlands.

This paper deals with the geohydrological relationships between the main surface waters in the lower parts of The Netherlands and the groundwater, including hydraulic resistance, rate of flow and travel times of water infiltrating from the surface water into the adjacent aquifer. For a pseudo-two-dimensional flow situation the hydraulic resistance, infiltration rate and average travel times can be calculated with simple analytical formulas, using a measured gradient line of the groundwater head. A linear relationship exists between the surface water level and the infiltration rate and an inverse relationship between this level and the average time water particles require to flow from the surface water to the (projection of) the bank. With numerical modelling, values of the hydraulic resistance and the infiltration rate in multi-aquifer situations of complex geometry can be calculated (by calibration). (Author's abstract)
W90-01019

**EVALUATION OF RAINFALL-DISCHARGE MODELS WITH DISCRIMINATION.**
University Coll., Galway (Ireland). Dept. of Engineering Hydrology.
For primary bibliographic entry see Field 2E.
W90-01020

**VARIATIONS IN CONCENTRATIONS OF AQUEOUS ALUMINIUM AND OTHER CHEMICAL SPECIES DURING HYDROLOGICAL EPISODES AT BIRKENES, SOUTHERNMOST NORWAY.**
Senter for Industriforskning, Oslo (Norway).
For primary bibliographic entry see Field 2K.
W90-01037

**SOIL HYDROPHOBIC EFFECTS ON INFILTRATION AND CATCHMENT RUNOFF.**
Department of Primary Industries and Energy, Canberra (Australia). Bureau of Rural Resources.
For primary bibliographic entry see Field 2G.
W90-01072

**RAIN-FLOW RATE MODELLING. A CONTRIBUTION TO THE DEVELOPMENT OF THE DPFT METHOD (MODELISATION PLUIE-DEBIT: VALIDATION PAR SIMULATION DE LA METHODE DPFT).**
Institut de Mecanique de Grenoble, Saint-Martin d'Heres (France).
For primary bibliographic entry see Field 7C.
W90-01133

**USE OF SOIL MOISTURE STATE INDICATORS IN A RAINFALL-RUNOFF MODEL (UTILISATION D'INDICATEURS DE L'ETAT HYDRIQUE DU SOL DANS UN MODELE PLUIE-DEBIT).**
Centre National du Machinisme Agricole, du Genie Rural, des Eaux et des Forets, Antony (France).
For primary bibliographic entry see Field 7C.
W90-01134

**ADDITIONAL RESULTS CONCERNING THE SPATIAL DISTRIBUTION OF RAINFALL AND ITS ROLE IN THE TRANSFORMATION OF RAINFALL-RUNOFF (LA DISTRIBUTION SPATIALE DES PRECIPITATIONS ET SON ROLE DANS LA TRANSFORMATION PLUIE-DEBIT).**
Institut de Mecanique de Grenoble, Saint-Martin d'Heres (France).
For primary bibliographic entry see Field 2B.
W90-01140

**RAINFALL RETENTION PROBABILITIES COMPUTED FOR DIFFERENT CROPPING-TILLAGE SYSTEMS.**
Agricultural Research Service, Tifton, GA. Southeast Watershed Research Center.
For primary bibliographic entry see Field 3F.
W90-01222

**METHOD OF SELECTING SUBSET AUTOREGRESSIVE TIME SERIES MODELS.**
Tamkang Univ., Taipei (Taiwan). Dept. of Hydraulic Engineering.
For primary bibliographic entry see Field 7C.
W90-01426

**FROM THE PLOT TO THE WATERSHED: SCALE EFFECT IN THE AMAZONIAN FOREST ECOSYSTEM (DE LA PARCELLE AU PETIT BASSIN-VERSANT: EFFET D'ECHELLE DANS L'ECOSYSTEME FORESTIER AMAZONIEN).**
Office de la Recherche Scientifique et Technique Outre-Mer, Cayenne (French Guiana).
For primary bibliographic entry see Field 4D.
W90-01444

**WATER RELEASE FROM A FORESTED SNOWPACK DURING RAINFALL.**
Pacific Southwest Forest and Range Experiment Station, Berkeley, CA.
R. Kattelmann.
IN: Forest Hydrology and Watershed Management. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication No. 167, 1987. p 265-272, 2 tab, 23 ref.

Descriptors: *Snowmelt, *Rainfall-runoff relationships, *Snowpack, *Runoff, *Forest hydrology, Rainfall, Sierra Nevada, California.

Snowpack water equivalent and snowpack outflow were monitored during several rain-on-snow events at a forest site and an adjacent open site in the Sierra Nevada of California. In all but two cases, the open snowpack lost more water than did the forest snowpack. The presence of a snowpack resulted in a delay of only a few hrs from the onset of rain until water was released to the soil. There was little difference in delay between the forest and open sites. (See also W90-01432) (Author's abstract)
W90-01457

**EFFECTS OF FORESTS ON WETLAND RUNOFF DURING SPRING.**
McMaster Univ., Hamilton (Ontario). Dept. of Geography.
M.-K. Woo, and R. Heron.
IN: Forest Hydrology and Watershed Management. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication No. 167, 1987. p 297-307, 5 fig, 10 ref.

Descriptors: *Surface-groundwater relations, *Groundwater movement, *Forest watersheds, *Forest hydrology, *Snowmelt, *Wetlands, *Surface runoff, Subarctic zone, Frozen ground, Seasonal variation.

Large expanses of wooded wetland cover the subarctic. During winter, the forests studied accumulated much drifting snow and in spring, the forested ones provided meltwater to the open wetlands. Since the forests occur on higher ground, they often produced groundwater mounds that deflected the paths of flow in the wetlands. Surface flow peaked in early spring but as meltwater supply diminished and as ground frost disappeared, groundwater flow prevailed in summer. (See also W90-01432) (Author's abstract)
W90-01460

**STREAMFLOW CHARACTERISTICS OF TWO SMALL, STEEP AND FORESTED WATERSHEDS IN HIGH ELEVATION AREAS OF CENTRAL TAIWAN.**
British Columbia Ministry of Forests, Kamloops. Hydrology Research Section.
For primary bibliographic entry see Field 2E.
W90-01478

**CHANGES IN STREAMFLOW PEAKS FOLLOWING TIMBER HARVEST OF A COASTAL BRITISH COLUMBIA WATERSHED.**
British Columbia Univ., Vancouver. Faculty of Forestry.
For primary bibliographic entry see Field 4C.
W90-01479

**RUNOFF FORMATION CONCEPT TO MODEL WATER PATHWAYS IN FORESTED BASINS.**
Technische Univ. Braunschweig (Germany, F.R.). Inst. fuer Geographie.
For primary bibliographic entry see Field 2E.
W90-01480

**EFFECT OF CLEARCUTTING ON STREAMFLOW GENERATING PROCESSES FROM A SUBALPINE FOREST SLOPE.**
Forest Service, Fort Collins, CO.
For primary bibliographic entry see Field 4C.
W90-01483

**EFFECT OF ASPEN HARVEST AND GROWTH ON WATER YIELD IN MINNESOTA.**
North Central Forest Experiment Station, Grand Rapids, MN. Forestry Sciences Lab.
For primary bibliographic entry see Field 2E.
W90-01484

**EXTRAPOLATION OF RESEARCH RESULTS BY DETERMINISTIC MODELS.**
Warsaw Univ. (Poland). Faculty of Geography and Regional Studies.
U. Soczynska.
IN: Forest Hydrology and Watershed Management. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication No. 167, 1987. p 585-594, 7 fig, 1 tab, 11 ref.

Descriptors: *Hydrologic models, *Rainfall-runoff relationships, *Watersheds, *Model studies, *Simulation analysis, Canopy, Surface flow, Physiographic parameters.

A deterministic, distributed, physically based model has been used to simulate the hydrological processes in a 15 sq km basin. Particular attention has been given to interception by the four-layer plant canopy, effective rainfall simulation and overland flow. The one-dimensional component was tested by comparing measured and computed soil moisture profiles and the three-dimensional one by comparing the simulated and measured volumes of flow from the basin. An implicit four point scheme was used in the numerical solution of the kinematic wave equations. Using the accumulated physiographic parameters and results, a data base of parameters was established that can be used to represent parameters of the physical environment as well as the hydrological season. (See also W90-01432) (Author's abstract)
W90-01487

**SIMULATION OF WATER FLOW AND SOIL EROSION PROCESSES WITH A DISTRIBUTED PHYSICALLY-BASED MODELLING SYSTEM.**
Dansk Hydraulisk Inst., Hoersholm.
For primary bibliographic entry see Field 2J.

W90-01488

**ANALYSIS OF STORMFLOW AND ITS SOURCE AREA EXPANSION THROUGH A SIMPLE KINEMATIC WAVE EQUATION.**
Forest and Forest Products Research Inst., Kyoto (Japan). Kansai Branch.
M. Tani, and T. Abe.
IN: Forest Hydrology and Watershed Management. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication No. 167, 1987. p 609-615, 5 fig, 10 ref.

Descriptors: *Kinematic wave theory, *Rainfall-runoff relationships, *Model studies, *Storm runoff, *Storms, *Surface flow, *Surface runoff, Manning formula, Soil water, Mountains, Hydrographs, Mathematical equations.

Characteristics of stormflow and its source area expansion in a mountainous basin were considered by analyzing responses of stormflow to rainfall. A simple kinematic wave equation was used for the analysis. Hydrographs for various storms observed in an experimental basin (17.3 ha) were well simulated through the analysis. It was found that the stormflow had more intense nonlinearity than that derived from the Manning formula, and that the source of the stormflow originated from the channel area and expanded upslope as rainfall increased. The expansion is generated by the distribution of the threshold soil water deficit, and it should also be reduced by the soil water movement after rainfall ceases. (See also W90-01432) (Author's abstract)
W90-01489

**INFLUENCE OF CLIMATE CHANGE AND CLIMATIC VARIABILITY ON THE HYDROLOGIC REGIME AND WATER RESOURCES.**
Proceedings of an International Symposium held during the XIXth General Assembly of the International Union of Geodesy and Geophysics at Vancouver, British Columbia, Canada, 9-22 August 1987. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. 1987. IAHS Publication No. 168. Edited by S. I. Solomon, M. Beran, and W. Hogg. 640p.

Descriptors: *Environmental impact, *Greenhouse effect, *Global warming, *Climatology, *Hydrological regime, *Resources management, *Symposium, Research priorities, Data interpretation, Geography, Hydrologic cycle, Glaciers, Rivers, Lakes, Paleoclimatology, Paleohydrology, Prediction.

Those approaching the subject of climatic change are confronted by a number of important initial questions that have not thus far received a satisfactory answer. Among them: (1) How one defines climatic variability and how it is distinct from climatic change; (2) The main causes of long and short term climatic change; (3) The extent to which people are inadvertently causing additional climatic variability or perhaps triggering climatic change; (4) The best ways of treating our data to detect and quantify variability and change; (5) The quantitative relationships between climatic and hydrologic variability and change; and (6) How mankind, which is so dependent upon water resources, could best deal with changes in their characteristics. The prodigious variety of papers submitted to this symposium indicates clearly the wide front on which climatic variability must be faced. Differences in geography and in technical standpoint make for obvious differences. However, the papers indicate an attack on the problem through the entire water cycle from atmospheric processes and feedbacks, through water in its solid form in glaciers, to quantity and quality examinations in rivers and lakes. There are also papers which take a global view of hydrology, pointing the way to a future growth area for climate-oriented studies. On the time axis too there are papers which deal with the remote past, with regional overview of current variability, and with attempts to predict resources in a 'warm-world' future. (See W90-01538 thru W90-01589) (Shidler-PTT)
W90-01537

**SOME EFFECTS OF CLIMATE VARIABILITY ON HYDROLOGY IN WESTERN NORTH AMERICA.**
Geological Survey, Menlo Park, CA.
D. H. Peterson, D. R. Cayan, J. DiLeo-Stevens, and T. G. Ross.
IN: The Influence of Climate Change and Climatic Variability on the Hydrologic Regime and Water Resources, International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication No. 168, 1987. p 45-62, 15 fig, 38 ref.

Descriptors: *Climatology, *Runoff variability, *Water quality, *Climates, *Hydrology, *North America, Precipitation, Runoff, Dissolved solids.

A strong north-south gradient in precipitation is experienced along the West Coast of North America, making this region an interesting laboratory for studying the influence of climate on runoff variability and riverine chemistry. Interannual fluctuations in large-scale atmospheric circulation and associated precipitation and runoff can produce major disruptions in the 'average' climatologic picture. Such fluctuations can be inferred and simplified from the time-averaged atmospheric pressure field and large-scale patterns of stream flow anomalies such as high or low stream flow. The effect of the climate gradient along western United States on the total dissolved solids concentrations in rivers is summarized as a highly idealized force-response model of total dissolved solids concentrations as a function of river flow. The response in wet years is more like the wetter climate response curves observed to the north and response in dry years is more like the drier response curves observed to the south. (See also W90-01537) (Author's abstract)
W90-01542

**CLIMATOLOGY OF DRY AND WET PERIODS OVER WESTERN CANADA IN A GENERAL CIRCULATION MODEL.**
Canadian Climate Centre, Downsview (Ontario).
For primary bibliographic entry see Field 2G.
W90-01546

**PALEOHYDROLOGIC STUDIES USING PROXY DATA AND OBSERVATIONS.**
Bundesanstalt fuer Gewaesserkunde, Koblenz (Germany, F.R.).
H. J. Liebscher.
IN: The Influence of Climate Change and Climatic Variability on the Hydrologic Regime and Water Resources, International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication No. 168, 1987. p 111-121, 2 fig, 33 ref.

Descriptors: *Climatology, *Rainfall variability, *Paleohydrology, *Global warming, *Hydrologic data collections, Forest dieback, Dating, History.

Paleohydrology is as yet a relatively young subsection of hydrology. However, it has gained significance through the expected temperature changes induced by increasing carbon dioxide concentrations and through the effects of forest dieback. Using results from global climate models, several institutions are attempting to quantify the impact of these changes on a global and mesoscale basis. This paper attempts briefly to describe and assess the current state of knowledge and information on hydrologic proxy data. Examples of these data are moraines, pollen profiles, annual tree rings, and isotope conditions. Proxy data can also be found in historical documents such as reports and pictorial representations of glaciers, information on times of grain and grape harvests as well as data on their quality and quantity. Hydrological proxy data also include a great amount of information taken from chronicles and other sources in which particular events, such as floods, drought, or ice cover in surface waters are reported. Using such data it is hoped that it will be possible to obtain a detailed picture--a temporally and spatially differentiated one--of the moisture and streamflow regimes of past times. (See also W90-01537) (Shidler-PTT)
W90-01547

**PALEOFLOOD HYDROLOGY AND HYDROCLIMATIC CHANGE.**
Arizona Univ., Tucson. Dept. of Geosciences.
V. R. Baker.
IN: The Influence of Climate Change and Climatic Variability on the Hydrologic Regime and Water Resources, International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication No. 168, 1987. p 123-131, 3 fig, 27 ref. NSF Grant EAR 81-19981.

Descriptors: *Rainfall variability, *Climatology, *Paleohydrology, *Historic floods, *Paleoclimatology, Fluvial sediments, Flood data, Geomorphology.

Important recent advances have been made in the reconstruction and interpretation of ancient floods, particularly in the use of slackwater deposits and paleostage indicators (SWD-PSI). For certain appropriate geomorphic settings, relatively accurate estimates of paleoflood discharges and ages can be made over time scales of centuries and millennia. New statistical tools are available to extract the maximum information content from this unconventional hydrologic data. Preliminary SWD-PSI study results from the southwestern United States indicate that certain time intervals in the last several thousand years have been characterized by occurrences of extraordinary floods, while other intervals have been relatively free of such events. Hydroclimatic change is a likely cause of this nonstationarity. (See also W90-01537) (Author's abstract)
W90-01548

**VARIABILITY IN PERIODICITIES EXHIBITED BY TREE RING DATA.**
Purdue Univ., Lafayette, IN. School of Civil Engineering.
A. R. Rao, and A. Durgunoglu.
IN: The Influence of Climate Change and Climatic Variability on the Hydrologic Regime and Water Resources, International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication No. 168, 1987. p 133-141, 6 fig, 3 tab, 8 ref.

Descriptors: *Climatology, *Rainfall variability, *Dendrochronology, *Paleoclimatology, Spectral analysis, Arizona.

Tree ring data have been widely used to study climatic variability. An interesting characteristic of the results from these studies is the apparent 'periodicity' in these time series. The regional consistency in the periodicities in tree-ring series is investigated in this study. If several series from a region have the same 'periodic' behavior then the argument for systematic climatic variability in that region would be quite strong. Consequently, investigation of 'periodicities' in tree-ring data in a region is important. Four tree-ring series in Salt and Verde river basins in Arizona are analyzed in this study. The Blackman-Tukey and a variant of the maximum entropy spectral analysis proposed by Marple are used. The data exhibit consistent periodic behavior although the periodicity is weak. (See also W90-01537) (Author's abstract)
W90-01549

**PALEORECHARGE, CLIMATOHYDROLOGIC VARIABILITY, AND WATER-RESOURCE MANAGEMENT.**
New Mexico Bureau of Mines and Mineral Resources, Socorro.
For primary bibliographic entry see Field 2F.
W90-01550

**MASS BALANCE OF NORTH CASCADE GLACIERS AND CLIMATIC IMPLICATIONS.**
Maine Univ. at Orono. Inst. for Quaternary Studies.
For primary bibliographic entry see Field 2C.
W90-01552

**ROLE OF STOCHASTIC HYDROLOGY IN DEALING WITH CLIMATIC VARIABILITY.**
Geological Survey, Reston, VA.
M. E. Moss, and G. D. Tasker.
IN: The Influence of Climate Change and Climatic Variability on the Hydrologic Regime and Water Resources, International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication No. 168, 1987. p 201-207, 1 fig, 15 ref.

Descriptors: *Model studies, *Global warming, *Climatology, *Hydrology, *Stochastic process, Weather, Uncertainty, Decision making.

Climate and the weather that it comprises provide the inputs and one of the primary driving forces to the hydrologic cycle. Because the climate and its interaction with hydrology cannot be described with full accuracy and precision, stochastic hydrology has been a useful technology. Three purposes for the use of stochastic hydrology can be identified: (1) a language for description of the uncertainties of hydrological processes, (2) a vehicle for the development of hydrologic insight, and (3) a tool in water-resources decision making. Each purpose will be reinforced during the next several decades in the light of anticipated climatic reactions to anthropogenic forces. However, stochastic hydrology must be carried to a higher scientific plane to deal with the transitory expectations of the future. (See also W90-01537) (Author's abstract)
W90-01555

**LONG WATER BALANCE TIME SERIES IN THE UPPER BASINS OF FOUR IMPORTANT RIVERS IN EUROPE--INDICATORS FOR CLIMATIC CHANGES.**
Service Hydrologique National, Bern (Switzerland).
B. Schadler.
IN: The Influence of Climate Change and Climatic Variability on the Hydrologic Regime and Water Resources, International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication No. 168, 1987. p 209-219, 6 fig, 1 tab, 8 ref.

Descriptors: *Rainfall variability, *Greenhouse effect, *Global warming, *Hydrologic budget, *Time series analysis, *Climatology, River basins, Model studies, Europe.

Long term time series of climate and water balance components are often used to identify climatic changes and check on climate models. Eighty-yr series of water balance components from 4 different basins in Switzerland (central Europe) are discussed together with a 175-yr series of the alpine basin of the Rhine: overall precipitation and evaporation have increased in accordance with the general rise in temperatures in the last 175 yrs. The increase in evaporation has been especially marked in this century despite major fluctuations in the precipitation figures. This effect is attributable, on the basis of comparisons with other areas, to human factors involving intensive agriculture. During winter months in recent yrs there has been a significant increase in the precipitation figures. The runoffs vary relatively little because of compensating effects. Time series of individual components of the water balance are evidently insufficient to allow climatic variations to be recognized or climatic models to be checked. (See also W90-01537) (Author's abstract)
W90-01556

**TEMPORAL DISAGGREGATION OF MONTHLY RAINFALL DATA FOR WATER BALANCE MODELLING.**
Hawaii Univ. at Manoa, Honolulu. Dept. of Geography.
For primary bibliographic entry see Field 2B.
W90-01560

**DROUGHT, RUNOFF AND SURFACE WATER RESOURCES--EFFECTS ON SMALL WATERSHEDS IN BURKINA FASO (SECHERESSE, DESERTIFICATION ET RESSOURCES EN EAU DE SURFACE--APPLICATION AUX PETITS BASSINS DU BURKINA FASO).**
Office de la Recherche Scientifique et Technique Outre-Mer, Montpellier (France). Lab. d'Hydrologie.
For primary bibliographic entry see Field 2B.
W90-01568

**GLOBAL CLIMATIC CHANGES AND REGIONAL HYDROLOGY: IMPACTS AND RESPONSES.**
California Univ., Berkeley. Energy and Resources Group.
P. H. Gleick.
IN: The Influence of Climate Change and Climatic Variability on the Hydrologic Regime and Water Resources, International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication No. 168, 1987. p 389-402, 5 fig, 1 tab, 33 ref.

Descriptors: *Greenhouse effect, *Climates, *Climatology, *Global warming, Carbon dioxide, Hydrology, Runoff, Soil water, Economic aspects, Political aspects, Water quality.

As the atmospheric concentration of CO2 and other trace gases increases, changes in global and regional climatic conditions will lead to a wide range of hydrologic impacts, including changes in the timing and magnitude of runoff and soil moisture. These hydrologic changes, in turn, will result in diverse economic, social and political consequences. The nature of the regional hydrologic effects depends on changes in the climatic conditions and the water-resource characteristics of the region. The research conducted to date has identified a wide range of potential problems--as well as some possible advantages--that might result from plausible changes in climate estimated by state-of-the-art general circulation models. These hydrologic changes fall into a series of distinct categories, including changes in the timing of water availability; changes in the magnitude of water availability; changes in the hydrologic variability; and effects on water quality. Similarly, diverse societal responses to the hydrologic changes are available, including adaptation, mitigation, and prevention. Each of these responses depends on the quality of the information available on future impacts and on the perceived importance of the effects. (See also W90-01537) (Author's abstract)
W90-01571

**MACROSCALE HYDROLOGIC MODELS IN SUPPORT TO CLIMATE RESEARCH.**
Institut fuer Wasserwirtschaft, Berlin (German D.R.).
A. Becker, and J. Nemec.
IN: The Influence of Climate Change and Climatic Variability on the Hydrologic Regime and Water Resources, International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication No. 168, 1987. p 431-445, 4 fig, 1 tab, 29 ref.

Descriptors: *Atmospheric circulation, *Simulation analysis, *Hydrologic models, *Climatology, Watersheds, Soil water, Evapotranspiration, Land surface modeling, Gaging, Grids.

For simulation experiments with atmospheric general circulation models (GCMs) more realistic information is required on certain land surface related hydrologic variables, in particular soil moisture and areal evapotranspiration. After reviewing in brief the present situation in large scale hydrologic land surface modelling a proposal is made for a grid related first level modelling which fulfills the requirements of GCMs and a subsequent second-level modelling which is used for validation of the first level and is river basin oriented. An important aspect of the proposed methodology is that it can be applied to any area of interest inside or outside gauged river basins, including the large GCM grid areas. The proposal takes into account existing experience in the application of grid techniques to river basin modelling as well as the important requirements to and recent developments relating to macroscale oriented hydrologic land surface modelling. (See also W90-01537) (Author's abstract)
W90-01574

**SPATIAL AND TEMPORAL VARIABILITY OF THE WATER BALANCE OF SOME WATERSHEDS IN WESTERN AFRICA IN RELATION TO CLIMATIC CHANGES (VARIABILITE SPATIALE ET TEMPORELLE DES BILANS HYDIPUES DE QUELQUES BASSINS VERSANTS D'AFRIQUE DEL'OUEST EN LIAISON AVEC LES CHENGEMENTS CLIMATIQUES).**
Office de la Recherche Scientifique et Technique Outre-Mer, Montpellier (France). Lab. d'Hydrologie.
B. Pouyaud.
IN: The Influence of Climate Change and Climatic Variability on the Hydrologic Regime and Water Resources, International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication No. 168, 1987. p 447-461, 5 fig, 9 tab, 10 ref. English summary.

Descriptors: *Climatology, *Africa, *Drought, *Water yield, *Rainfall-runoff relationships, Watersheds, Hydrologic budget.

The drought of the last 15 yrs in western Africa has a seemingly contradictory influence over the water yield of watersheds smaller than 500 sq km and that of lg river basins such as the Senegal and Niger rivers. The water balance components over eight watersheds, area ranging from 1,000 to 100,000 sq km, and rainfall from 400 to 1,000 mm was studied. The spatial and temporal variability of the water balance relative to climatic changes is emphasized. A new approach to the problem is proposed which should help explain how the increase in runoff of intermediate watersheds gives place to the deficit observed at the outlet of the great water basins. At this scale the major conceptual discontinuity in the rainfall runoff relationship takes place. (See also W90-01575) (Author's abstract)
W90-01575

**HISTORICAL VARIATIONS IN AFRICAN WATER RESOURCES.**
Institute of Hydrology, Wallingford (England).
J. V. Sutcliffe, and D. G. Knott.
IN: The Influence of Climate Change and Climatic Variability on the Hydrologic Regime and Water Resources, International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication No. 168, 1987. p 463-476, 7 fig, 1 tab, 15 ref.

Descriptors: *Climatology, *Rainfall variability, *Paleohydrology, *Africa, *River basins, *Runoff, *Rainfall, Historical perspective, Flow pattern, Flow profiles.

The variability of African water resources is studied through historic flow records. Spatial variability is linked to rainfall distribution and areas of high runoff are limited in extent. Annual runoff is sensitive to rainfall variations and 7 yr moving averages on a number of rivers are presented and compared. The flows of the Senegal and Niger are very similar, which would be expected as they derive from adjacent areas of surplus rainfall. The range of seven year mean flows is itself very wide, particularly for the Senegal where the recent mean is only a third of earlier peaks and the recent drought has been much more severe than previous droughts. The pattern of flows in other west African rivers like the Volta, the Konkoure in Guinea, the Bandama, and the Oueme have been similar to the Niger and Senegal. Long term homogeneous river flow series are not available in all parts of Africa. In general, the francophone countries appear to be better provided with long-term river flow records, while the anglophone countries have shorter flow records but a number of long-term rainfall records. (See also W90-01537) (White-Reimer-PTT)
W90-01576

**CLIMATIC CHANGE AND GREAT LAKES WATER LEVELS.**

Windsor Univ. (Ontario). Great Lakes Inst.
For primary bibliographic entry see Field 2B.
W90-01577

**SENSITIVITY OF WATER RESOURCES IN THE GREAT LAKES REGION TO CHANGES IN TEMPERATURE, PRECIPITATION, HUMIDITY, AND WIND SPEED.**
Canadian Climate Centre, Downsview (Ontario).
For primary bibliographic entry see Field 2B.
W90-01578

**PERSISTENT CONSEQUENCES OF THE PRESENT DROUGHT ON THE FLOWS OF THE SENEGAL RIVER AND THE HYPERSALINISATION OF THE LOWER CASAMANCE (LES CONSEQUENCES DURABLES DE LA SECHERESSE ACTUELLE SUR L'ECULEMENT DU FLEUVE SENEGAL ET L'HYPERSALINISATION DE LA BASSE-CASAMANCE).**
Office de la Recherche Scientifique et Technique Outre-Mer, Paris (France).
For primary bibliographic entry see Field 2B.
W90-01579

**EFFECT OF CLIMATE CHANGES ON THE PRECIPITATION PATTERNS AND ISOTOPIC COMPOSITION OF WATER IN A CLIMATE TRANSITION ZONE: CASE OF THE EASTERN MEDITERRANEAN SEA AREA.**
Weizmann Inst. of Science, Rehovoth (Israel). Dept. of Isotope Research.
For primary bibliographic entry see Field 2B.
W90-01580

**CLIMATIC VARIABILITY AND REGOLITH GROUNDWATER REGIME IN SOUTHWESTERN NIGERIA.**
Ife Univ. (Nigeria). Dept. of Geography.
For primary bibliographic entry see Field 2B.
W90-01581

**LONG-TERM CHANGES IN WATER QUALITY PARAMETERS OF A SHALLOW EUTROPHIC LAKE AND THEIR RELATIONS TO METEOROLOGIC AND HYDROLOGIC ELEMENTS.**
Akademie der Wissenschaften der DDR, Berlin. Inst. fuer Geographie und Geooekologie.
For primary bibliographic entry see Field 2H.
W90-01582

**HYDROLOGIC DESIGN CRITERIA AND CLIMATE VARIABILITY.**
Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.
For primary bibliographic entry see Field 8A.
W90-01583

**METHODOLOGY FOR DISTINGUISHING BETWEEN THE EFFECTS OF HUMAN INFLUENCE AND CLIMATE VARIABILITY ON THE HYDROLOGIC CYCLE.**
Dansk Hydraulisk Inst., Hoersholm.
For primary bibliographic entry see Field 4C.
W90-01584

**SOME POSSIBLE IMPACTS OF GREENHOUSE GAS INDUCED CLIMATIC CHANGE ON WATER RESOURCES IN ENGLAND AND WALES.**
University of East Anglia, Norwich (England). Climatic Research Unit.
For primary bibliographic entry see Field 2B.
W90-01586

**HYDROLOGIC RESPONSE TO AN ARTIFICIAL CLIMATIC CHANGE OF RAINFALL ENHANCEMENT.**
Ministry of Agriculture, Jerusalem (Israel). Hydrological Service.
For primary bibliographic entry see Field 2B.
W90-01588

**WILL CLOUDS PROVIDE A NEGATIVE FEEDBACK IN A CO2-WARMED WORLD.**
Liverpool Univ. (England). Dept. of Geography.
For primary bibliographic entry see Field 2B.
W90-01589

**LIQUID MOISTURE REDISTRIBUTION: HYDROLOGIC SIMULATION AND SPATIAL VARIABILITY.**
Texas Univ. at Austin. Dept. of Civil Engineering.
R. J. Charbeneau.
IN: Unsaturated Flow in Hydrologic Modeling: Theory and Practice. Kluwer Academic Publishers, Boston. 1989. p 127-160, 14 fig, 29 ref.

Descriptors: *Soil water, *Evapotranspiration, *Groundwater recharge, *Moisture profiles, *Model studies, Mathematical models, Soil moisture retention, Soil types, Evaporation rate, Infiltration.

Liquid moisture redistribution processes begin when the infiltration for a rainfall or irrigation period comes to an end. Redistribution processes include the downward migration of soil moisture to eventually recharge the water table and the loss of water to the atmosphere through evapotranspiration. The application of relatively simple, physically based profile models for simulation of redistribution is reviewed. Continuity and Darcy's law were applied to the rectangular and kinematic profiles to model the change in water content and flux as a function of depth and time. Both initial conditions and evaporation were included, along with the use of probabilistic methods for addressing questions of spatial variability. (See also W90-01590) (Author's abstract)
W90-01595

**EVALUATION OF THE HYDROLOGICAL RESPONSE OF A DRAINAGE NETWORK.**
Ecole Polytechnique Federale de Lausanne (Switzerland). Inst. for Agricultural Engineering.
A. Musy, M. Soutter, and P. Perrochet.
IN: Unsaturated Flow in Hydrologic Modeling: Theory and Practice. Kluwer Academic Publishers, Boston. 1989. p 161-188, 13 fig, 11 ref.

Descriptors: *Rural areas, *Drainage systems, *Soil water, *Model studies, *Hydrographs, Drains, Mathematical analysis.

The hydrological behavior of a rural watershed may be significantly influenced by the presence of one or more drained areas. The objective of this contribution is to present different methods that permit the evaluation of the hydrological response of a drainage network, and consequently its impact on the whole basin. The process of transfer of water from the soil surface to the outlet of the network of pipes includes two stages: First the transfer within the soil, resulting in flow hydrographs into the drains, and second their spreading into the network of pipes, resulting in the flow hydrograph at its outlet. Two simulation models, respectively designated SIDRA and SAT/NSAT, are presented with some illustrative examples. (See also W90-01590) (Author's abstract)
W90-01596

**INTERFLOW.**
Lancaster Univ. (England). Centre for Research on Environmental Systems.
K. Bevan.
IN: Unsaturated Flow in Hydrologic Modeling: Theory and Practice. Kluwer Academic Publishers, Boston. 1989. p 191-219, 9 fig, 106 ref.

Descriptors: *Rainfall-runoff relationships, *Storm runoff, *Storm seepage, *Soil water, *Subsurface water, *Model studies, *Surface-groundwater relations, Return flow, Macropore flow, Translatory flow, Hydrographs, Infiltration.

Storm runoff in many parts of the world is produced by subsurface runoff processes or interflow. The evidence for different mechanisms (e.g. translatory flow, macropore flow, groundwater ridging, return flows) to explain fast subsurface responses is reviewed. The different mechanisms were incorporated into a unified conceptual model of interflows that highlights the importance of spatial heterogeneity and preferential flow pathways. Approaches to modelling interflows are reviewed, both by Darcian mechanisms and incorporating the effects of macropores. The difficulties of deconvoluting different process contributions to slope responses is discussed in terms of a distribution function concept. An approach to modelling interflows that incorporates the estimation of predictive uncertainties is outlined. (See also W90-01590) (Author's abstract)
W90-01597

**REMOTE SENSING OF WATERSHED CHARACTERISTICS AND RAINFALL INPUT.**
Ruhr Univ., Bochum (Germany, F.R.).
For primary bibliographic entry see Field 7B.
W90-01601

**LOSS RATE REPRESENTATION IN THE HEC-1 WATERSHED MODEL.**
Hydrologic Engineering Center, Davis, CA.
D. M. Goldman.
IN: Unsaturated Flow in Hydrologic Modeling: Theory and Practice. Kluwer Academic Publishers, Boston. 1989. p 345-390, 12 fig, 7 tab, 39 ref.

Descriptors: *Model studies, *Computer programs, *Rainfall-runoff relationships, Hydrographs, Unit hydrographs, Unsaturated flow, Storm seepage, Mathematical analysis, Agricultural watersheds, Urban watersheds.

The HEC-1 watershed model is a loss rate method used for single event analysis. Five different loss rate functions may be selected for a single event simulation. A parameter estimation technique is available in HEC-1 for automatically estimating the loss rate and unit hydrograph parameters that best reproduce an observed hydrograph. Any of the loss rate techniques in HEC-1 can be used with this parameter estimation technique. However, the use of only two parameters, such as an initial and constant loss will probably reproduce a hydrograph well enough for most purposes. A portion of the rainfall loss will contribute to the hydrograph via subsurface flow. HEC-1 provides an empirical three parameter method for simulating the contributions of subsurface flow. Case study examples are provided which describe the results of using the HEC-1 loss rate methodology to a variety of watershed types, small agricultural watersheds (40 acres), an urban watershed (4 sq mi), and a large natural watershed (8,000 sq mi). The case studies demonstrate that the most difficult part of watershed modeling is the estimation of loss rates. (See also W90-01590) (Peters-PTT)
W90-01603

**HYDROLOGICAL PROCESSES AND WATER MANAGEMENT IN URBAN AREAS.**
Proceedings of the International Symposium 24-29 April 1988, Duisberg, West Germany. International Hydrological Programme of UNESCO Publication, 1988. 885p.

Descriptors: *Urban hydrology, *Urban planning, *Water management, Hydrologic cycle, Urban watersheds, Urban areas, Flood protection, Urbanization, Groundwater, Surface water, Rainfall-runoff relationships.

The design and management of urban water systems is increasingly being based on hydrological studies. The integration of know-how on various aspects of urban hydrology, such as water supply and sanitation, town and regional planning, ecology and hygiene, is crucial. Moreover, the application of advanced technologies and the transfer of knowledge and experiences are the most important items to researchers as well as to planners, managers and decision makers. This symposium is considered to be a contribution to the realization of this long-term target. Research findings on six themes (urban hydrological cycle, functions and uses of water in urbanized areas, concepts of urban drainage and flood protection, effects of urbanization on surface waters and groundwater, role of water in

urbanized areas and city planning, and integrated water management in urban areas), experiences with integrated water management and views on the role of water in city planning, are presented. This volume contains 89 papers and 19 posters by 167 authors from 31 countries. (See W90-01612 thru W90-01701) (Lantz-PTT)
W90-01612

**INFLUENCE OF THE METHOD FOR EFFECTIVE RAIN DETERMINATION ON THE PARAMETERS OF NASH MODEL FOR URBANIZED WATERSHED.**
Agricultural Univ. of Warsaw (Poland).
For primary bibliographic entry see Field 2B.
W90-01613

**HYDROLOGICAL BALANCE CHANGES IN URBANIZED TERRITORY.**
Slovenska Akademia Vied, Bratislava (Czechoslovakia). Ustav Hydrologie a Hydrauliky.
For primary bibliographic entry see Field 4C.
W90-01614

**URBAN WATER BALANCE IN THE RHENISH LIGNITE AREA.**
For primary bibliographic entry see Field 4C.
W90-01616

**ASPECTS OF URBAN HYDROLOGY IN DEVELOPING COUNTRIES: A CASE STUDY OF ADDIS ABABA.**
Addis Ababa Univ. (Ethiopia). Faculty of Technology.
For primary bibliographic entry see Field 4C.
W90-01618

**PRINCIPLES OF URBAN HYDROLOGY.**
Gosudarstvennyi Gidrologicheskii Inst., Leningrad (USSR).
For primary bibliographic entry see Field 4A.
W90-01619

**STOCHASTIC ANALYSIS OF RAINFALL FOR URBAN DRAINAGE STUDIES.**
McGill Univ., Montreal (Quebec).
V. T. V. Nguyen.
IN: Hydrological Processes and Water Management in Urban Areas. Proceedings of the International Symposium 24-29 April 1988, Duisburg, West Germany. International Hydrological Programme of UNESCO Publication, 1988. p 77-84, 3 fig, 9 ref.

Descriptors: *Stochastic process, *Rainfall-runoff relationships, *Urban drainage, *Urban hydrology, Drainage systems, Stochastic analysis, Hydrologic models, Mathematical models.

Two stochastic methods for the characterization of rainfall for urban drainage studies are described. First, a general stochastic model is proposed to analytically determine the cumulative distribution function for storm volume. Second, an analytical procedure is presented to evaluate the mean temporal storm pattern. Results of a numerical application demonstrate the adequacy of these methods. It is concluded that the suggested methods are more general and flexible than empirical approaches because they can take into account the different stochastic properties of the underlying rainfall process. (See also W90-01612) (Author's abstract)
W90-01621

**RECENT TRENDS IN PRECIPITATION AND THE WATER BALANCE OF TROPICAL CITIES: THE EXAMPLE OF LAGOS, NIGERIA.**
Lagos Univ. (Nigeria). Dept. of Geography.
O. Ojo.
IN: Hydrological Processes and Water Management in Urban Areas. Proceedings of the International Symposium 24-29 April 1988, Duisburg, West Germany. International Hydrological Programme of UNESCO Publication, 1988. p 95-106, 4 fig, 2 ref.

Descriptors: *Hydrologic budget, *Precipitation, *Urban hydrology, *Tropical regions, *Lagos, *Nigeria, Developing countries, Climatology, Urban areas.

In recent years the occurrences of hydroclimatic variabilities and their consequences on man in different parts of the world have demonstrated the sensitivity of human welfare and a nation's economic development to hydroclimatic events. In urban areas, the trends in water supply depends upon precipitation. This is the case in tropical cities, where the impact of recent variabilities in precipitation have led to considerable shortages in water supply and a lot of hardship for the urban population. A survey was conducted of recent trends in the precipitation and water balance in tropical cities, with particular reference to Lagos, Nigeria. The results of the water balance computation is examined, relating current and future needs of water in the metropolis. Aspects of the water problem rising from fluctuations in precipitation, the water balance components, and the utilization of water by the projected population, are discussed. (See also W90-01612)(Lantz-PTT)
W90-01623

**INTERACTION OF FLOOD WATER FLOWS IN SEWER NETWORKS AND SMALL RIVER SYSTEMS.**
Ingenieurbuero fuer Conrath und Partner, Spiesen-Elversberg (Germany, F.R.).
J. Sartor.
IN: Hydrological Processes and Water Management in Urban Areas. Proceedings of the International Symposium 24-29 April 1988, Duisburg, West Germany. International Hydrological Programme of UNESCO Publication, 1988. p 113-120, 4 fig, 3 ref.

Descriptors: *Urban hydrology, *Floodwater, *Rivers, *Sewers, *Rainfall-runoff relationships, Sewer infiltration, Surface water, Hydraulics, Floods, Hydrologic studies.

In the transition region from sewer to river, the penetration of river flood water into the sewer network or the hydraulic overload of small rivers due to sewer system discharges, may occur. Cost effective solutions for these problems are nearly impossible to determine because of the probability of the simultaneous occurrence of sewer and river flood events can not be answered. At first, the degree to which the two events are dependent, must be investigated. This mainly depends on the watershed characteristics and the meteorologic processes. It is most likely that a given situation will lie between the following two extremes. At one extreme, both catchment areas are similar in size and hydrological character (e.g., concentration times). At the other extreme, both catchment areas differ very much in size and hydrologic character. Equally distributed rainfall is not likely to occur and riverine flooding often results from snowmelt. Thus, the likelihood is very high that both events are independent and coincidence occurs randomly. The author describes the different natures of both flood events and presents a new method to determine their coincident probability. (See also W90-01612) (Lantz-PTT)
W90-01625

**WATER BALANCE TECHNIQUES APPLIED TO INDUSTRIAL COMPLEXES.**
Laboratorium voor Grondmechanica, Delft (Netherlands).
H. T. Sman, C. C. D. F. Van Ree, and M. Loxham.
IN: Hydrological Processes and Water Management in Urban Areas. Proceedings of the International Symposium 24-29 April 1988, Duisburg, West Germany. International Hydrological Programme of UNESCO Publication, 1988. p 121-128, 2 fig, 2 tab.

Descriptors: *Hydrologic budget, *Industrial plants, *Mathematical studies, *Urban hydrology, *Ecological effects, Evaporation, Runoff, Water storage, Groundwater movement, Simulation analysis.

Industrial complexes are a major factor in the environmental and ecological impact assessment of urban areas. This impact can be seen in terms of micro-climate modifications, noise and vibration levels, and especially in the changes to the geohydrological regime on the local scale, both in terms of quantity and quality. The starting point of a quantitative assessment of the hydrology of such a site is the classical water balance. While the different terms of water balance remain the same as that for natural systems, the actual evaporation, runoff and storage have completely different values because of the site development and infrastructure. Water balance calculations are presented for a whole complex as a single unit, and on a more detailed scale through the use of computer simulations, taking local construction features into account. The simulations allowed the calculation of the groundwater flow pattern, from which different components could be estimated. Good fit was found between measured and calculated data of groundwater levels. The study indicates a lack of information on the detailed contribution of individual infrastructural elements to the overall balance. However, it has demonstrated that the illustrated techniques can be successfully used in this type of study. (See also W90-01612)(Author's abstract)
W90-01626

**REDUCTION MEASURES FOR FLOOD RUNOFF AND THE ESTIMATION OF THE EFFECTIVE RAINFALL OF THE SMALL RIVERS IN TOKYO METROPOLIS.**
Institute of Civil Engineering, Tokyo (Japan).
I. Kiyoshi, K. Hideo, and M. Masaru.
IN: Hydrological Processes and Water Management in Urban Areas. Proceedings of the International Symposium 24-29 April 1988, Duisburg, West Germany. International Hydrological Programme of UNESCO Publication, 1988. p 295-302, 4 fig, 1 tab, 1 ref.

Descriptors: *Urban hydrology, *Urban runoff, *Rainfall-runoff relationships, *Floods, *Tokyo, *Japan, Infiltration, Flood control, Mathematical studies.

Recently, in the river basins of Tokyo, Japan, flood runoff has been reduced by storage and infiltration facilities located on public properties such as roads and parks, in order to achieve comprehensive flood control. The effects of these flood control measures are estimated by using empirical equations for effective rainfall, obtained through urban runoff analyses. (See also W90-01612) (Author's abstract)
W90-01644

**HYDROMETRIC DATA CAPTURE USING INTELLIGENT SOLID STATE LOGGING SYSTEMS.**
Severn-Trent Water Authority, Birmingham (England).
For primary bibliographic entry see Field 7A.
W90-01816

**SATELLITE DATA AS A BASIS FOR THE ESTIMATION OF RAINFALL AND RUNOFF.**
Ruhr Univ., Bochum (Germany, F.R.).
For primary bibliographic entry see Field 7B.
W90-01820

**TOWARDS A SATELLITE-BASED HYDROMETRIC DATA COLLECTION SYSTEM.**
Department of the Environment, Reading (England). Water Data Unit.
For primary bibliographic entry see Field 7B.
W90-01821

**ADVANCED HYDROLOGIC INSTRUMENTATION ACTIVITIES WITHIN THE WATER RESOURCES DIVISION OF THE US GEOLOGICAL SURVEY.**
Geological Survey, Reston, VA. Water Resources Div.
For primary bibliographic entry see Field 7B.
W90-01827

## Field 2—WATER CYCLE

### Group 2A—General

**HYDROLOGY OF IRRIGATION AND THE IMPACT OF IRRIGATION ON THE HYDROLOGIC CYCLE.**
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 3F.
W90-01832

**LARGE SCALE EFFECTS OF SEASONAL SNOW COVER AND TEMPERATURE INCREASE ON RUNOFF.**
Agricultural Research Service, Beltsville, MD. Hydrology Lab.
For primary bibliographic entry see Field 2C.
W90-01861

### 2B. Precipitation

**COMBINATION OF RADAR AND GAUGE DATA IN A RAINFALL ARCHIVE SYSTEM.**
For primary bibliographic entry see Field 7A.
W90-00967

**EVALUATION OF RAINFALL-DISCHARGE MODELS WITH DISCRIMINATION.**
University Coll., Galway (Ireland). Dept. of Engineering Hydrology.
For primary bibliographic entry see Field 2E.
W90-01020

**DETERMINING RUNOFF ROUTING MODEL PARAMETERS WITHOUT RAINFALL DATA.**
Wollongong Univ. (Australia). Dept. of Civil and Mining Engineering.
For primary bibliographic entry see Field 2E.
W90-01031

**STUDIES ON NON-PRECIPITATING CUMULUS CLOUD ACIDIFICATION.**
Kentucky Univ., Lexington. Dept. of Chemical Engineering.
For primary bibliographic entry see Field 5B.
W90-01061

**SIMPLE PROCEDURES FOR EXTRAPOLATION OF HUMIDITY VARIABLES IN THE MOUNTAINOUS WESTERN UNITED STATES.**
New Mexico State Univ., Las Cruces. Dept. of Agronomy and Horticulture.
K. E. Kunkel.
Journal of Climate JLCLEL, Vol. 2, No. 7, p 656-669, Jul 1989. 10 fig, 5 tab, 8 ref, append.

Descriptors: *Humidity, *Mountains, *Climatology, *Dewpoint, Temperature, Seasonal variation.

A series of simple procedures are presented for extrapolating climatic averages of humidity variables from a reference location with long-term humidity measurements to nearby higher elevation locations. The extrapolation of monthly average dewpoint temperature is accomplished by using an exponential function for the height decrease of water vapor pressure. This procedure results in a lapse rate of dewpoint temperature which is to a first approximation a constant. The root-mean-square (rms) error in estimating dewpoint temperature at nine higher elevation locations averaged 1.1 C. Summer wet-bulb design temperatures are estimated using a region-wide lapse rate of 4.4 C/km. The rms error in estimating 1%, 2.5%, and 5% wet-bulb design temperatures at 12 higher elevation locations was 0.9 C. Three-hour monthly average wet-bulb temperatures and relative humidity are estimated from the 3-hour monthly average dewpoint temperature and the 3-hour monthly average air temperature at the reference location with the following procedure. An estimate of the 3-hour monthly average air temperature at the desired location is obtained using an average lapse rate calculated from the monthly mean maximum and minimum temperatures at the two locations. An estimate of 3-hour monthly average dewpoint temperature is obtained using the same procedure that was developed for monthly average dewpoint temperature. Estimates of 34-hour monthly average wet-bulb temperature and relative humidity are then calculated from the estimated air and dewpoint temperatures. A test of this procedure for two station pairs resulted in good agreement for 3-hour monthly average air and wet-bulb temperatures with rms values of 0.8 C and 0.7; C, respectively. The rms error for 3-hour monthly average relative humidity was 5%, however, with some individual errors around 10%. (Author's abstract)
W90-01065

**QUANTITATIVE RAINFALL FORECAST (PREVISION QUANTITATIVE DES PRECIPITATIONS).**
Meteorologie Nationale, Paris (France). Div. Prevision.
For primary bibliographic entry see Field 7C.
W90-01138

**HYDROLOGICAL RADAR: RESULTS AND EXPERIMENTS CURRENTLY BEING CONDUCTED IN FRANCE (HYDROLOGIE RADAR: BILAN ET PERSPECTIVES).**
Institut de Mecanique de Grenoble, Saint-Martin d'Heres (France).
For primary bibliographic entry see Field 7B.
W90-01139

**ADDITIONAL RESULTS CONCERNING THE SPATIAL DISTRIBUTION OF RAINFALL AND ITS ROLE IN THE TRANSFORMATION OF RAINFALL-RUNOFF (LA DISTRIBUTION SPATIALE DES PRECIPITATIONS ET SON ROLE DANS LA TRANSFORMATION PLUIE-DEBIT).**
Institut de Mecanique de Grenoble, Saint-Martin d'Heres (France).
C. Obled, and Y. Rodriguez.
La Houille Blanche HOBLAB, Vol. 5, No. 6, p 467-474, 1988. 10 fig, 1 tab, English summary.

Descriptors: *Rainfall distribution, *Rainfall-runoff relationships, *Isohyets, Precipitation, Spatial distribution, Model studies.

In a preliminary study, the calculation of time pitch isohyet surfaces is discussed. The importance of being fully familiar with the spatial distribution of rainfall is emphasized so that the individual responses of sub-basins may be identified by selecting the irregular intervals when they have been excited in various ways by the input of rain. The effect, even with average rainfall, between highly concentrated isohyets on the discharge response is emphasized. These observations, obtained in the Gardon d'Anduze, France (500 sq km), are currently being modelled. (Author's abstract)
W90-01140

**WINTER STORM STRUCTURE AND MELTING-INDUCED CIRCULATIONS.**
Atmospheric Environment Service, Downsview (Ontario). Cloud Physics Research Div.
R. E. Stewart, and S. R. Macpherson.
Atmosphere-Ocean ATOCDA, Vol. 27, No. 1, p 5-23, March 1989. 11 fig, 29 ref.

Descriptors: *Meteorology, *Weather, *Storms, *Air circulation, *Precipitation, *Snow, Atmospheric physics, Atmospheric water, Meteorological data collection, Weather data collections.

Extensive observations were made of a winter storm that crossed eastern Canada on 10-12 March 1986 during the Canadian Atlantic Storms Program (CASP) field project. A kinematic description of the storm is established by using isentropic analysis and this description is compared with storm observations in other regions as well as with other ASP storms. The occurrence and role of snow and freezing precipitation in this storm are highlighted. A melting-induced mesoscale circulation in the storm was consistent with uplift in the snow, surface Arctic fronts near the O C isotherm, and the separation of conveyor belts. It was suggested that the evolution of this circulation would lead to cyclogenesis. This is consistent with the organization of the main system, the observations of secondary low development along the Arctic front immediately west of the upper front, as well as of low centers having deep 0 C layers. Melting and refreezing tend to produce strong stable layers within the storms, but, in concert with vertical and horizontal motions, they also force other regions of the atmosphere toward neutrality. The melting process would also be expected to work together with other cyclogenesis forcings, such as orography and air-sea interaction. These findings tend to illustrate that a winter storm exhibits a substantial, and evolving, organization. Microphysical processes that control latent heating are believed to be critically important in defining some of a winter storm's mesoscale fields as well as its overall nature. (Author's abstract)
W90-01212

**NATURE OF RAPIDLY DEEPENING CANADIAN EAST COAST WINTER STORMS.**
Atmospheric Environment Service, Downsview (Ontario). Cloud Physics Research Div.
R. E. Stewart, and N. R. Donaldson.
Atmosphere-Ocean ATOCDA, Vol. 27, No. 1, p 87-107, March 1989. 14 fig, 1 tab, 27 ref.

Descriptors: *Meteorology, *Canada, *Storms, *Weather, *Precipitation, *Weather data collections, Meteorological data collection, Rainfall, Snow, Air circulation, Atmospheric water, Atmospheric physics.

During the Canadian Atlantic Storms Program (CASP) field project from 15 January to 15 March 1986, seven storms underwent rapid deepening either within or adjacent to the observational network. The most rapid deepening phase of these storms was associated with the surface low-pressure center being located close to the rain-snow boundary and the end of this phase was associated with the low center eventually moving to subfreezing surface temperatures. Precipitation bands of both rain and snow occurred during maximum deepening. Observations are consistent with divergence and subsidence occurring near the center itself. It is suggested that a mesoscale circulation initiated by melting snow significantly affects the deepening process. (Author's abstract)
W90-01213

**PRECIPITATION REGIONS WITHIN TWO STORMS AFFECTING ATLANTIC CANADA.**
Atmospheric Environment Service, Downsview (Ontario). Cloud Physics Research Div.
N. R. Donaldson, and R. E. Stewart.
Atmosphere-Ocean ATOCDA, Vol. 27, No. 1, p 108-129, March 1989. 14 fig, 17 ref.

Descriptors: *Meteorology, *Storms, *Weather, *Precipitation, *Canada, Meteorological data collection, Weather data collections, Rainfall, Atmospheric water, Atmospheric physics.

Two storms that produced heavy precipitation during the Canadian Atlantic Storms Program (CASP) field project are examined, with particular emphasis on their northern and western sectors. Precipitation was associated with upwards motion along the edges of an elevated warm core north of the surface low center. Within the general pattern of precipitation, the highest rates occurred in narrow bands that were generally aligned with isotherms. The warm core contains regions of marginal symmetric instability and some of absolute instability. The origin of the precipitation bands is linked to the organized response of the atmosphere to the stability and wind fields associated with the entire cyclone system. (Author's abstract)
W90-01214

**PRECIPITATION IN THE CANADIAN ATLANTIC STORMS PROGRAM: MEASUREMENTS OF THE ACOUSTIC SIGNATURE.**
Naval Postgraduate School, Monterey, CA. Dept. of Oceanography.
J. A. Nystuen, and D. M. Farmer.
Atmosphere-Ocean ATOCDA, Vol. 27, No. 1, p 237-257, March 1989. 14 fig, 1 tab, 22 ref.

Descriptors: *Canada, *Precipitation, *Storms, *Weather, *Remote sensing, *Meteorology, *Radar, Weather data collections, Meteorological data collection, Rainfall, Atmospheric water, Wind.

The Canadian Atlantic Storms Program (CASP) provided an opportunity for comparing two quite different remote-sensing approaches to the detection of precipitation: radar backscatter and ambient ocean sound. Several of the gales passing the observation area during CASP produced substantial precipitation with the periods of radar backscatter showing close coincidence with simultaneous acoustic signals. The ambient sound record most readily yield an indication of precipitation from shifts in spectral slope. An important result of the experiment is the demonstration that an identifiable precipitation signal occurs even in strong wind conditions. The surface bubble layer formed during strong winds only partially attenuates the higher frequency acoustic components generated by precipitation. During rain-free periods the attenuation can be interpreted in terms of the bubble size distribution. (Author's abstract)
W90-01215

**SPECTRAL CHARACTERISTICS OF THE ANNUAL RAINFALL SERIES FOR NORTHEAST BRAZIL.**
Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
R. P. Kane, and N. B. Trivedi.
Climatic Change CLCHDX, Vol. 13, No. 3, p 317-336, December 1988. 10 fig, 2 tab, 40 ref. FNDCT Brazil Contract FINEP 537/CT.

Descriptors: *Meteorology, *Climatology, *Rainfall, *Precipitation, *Brazil, *Weather data collections, Meteorological data collection, Drought, Statistical methods.

The rainfall series for Fortaleza (Ceara) is compared with similar series for several other locations in Northeast Brazil. It is shown that the correlations are high for distances up to about 600 km from Fortaleza. The Fortaleza series shows prominent periodicities at T=2.1, 10.1, 12.9, 25.1, and 61.0 years, all significant at a 3-sigma a priori level. Among these, T=12.9 and 25.1 years are significant at a 4-sigma a priori level. A master curve (for 1912-1978 only), obtained by averaging rainfall data for 93 stations having good correlations with Fortaleza, shows very prominent periodicities at T=5.6, 12.3, and 47.3 years, significant at a 3-sigma a priori level. T=12.3 is significant at a 4-sigma a priori level. Predictions for both the Fortaleza series (1849-1976) and the Master Curve (1912-1978) indicated droughts during 1979-1983. This prediction seems to have verified. In the future, droughts during 1992-1994 and 2002-2006 are indicated. (Author's abstract)
W90-01231

**RELATIONSHIP BETWEEN RAIN AND SNOW ACIDITY AND AIR MASS TRAJECTORY IN EASTERN FRANCE.**
Paris-7 Univ. (France). Lab. de Physico-Chimie de l'Atmosphere.
For primary bibliographic entry see Field 5B.
W90-01249

**STUDY OF THE SOURCES OF ACID PRECIPITATION IN ONTARIO, CANADA.**
Illinois Univ., Urbana. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W90-01250

**RELATIONSHIP BETWEEN SECONDARY SULFATE AND PRIMARY REGIONAL SIGNATURES IN NORTHEASTERN AEROSOL AND PRECIPITATION.**
Rhode Island Univ., Narragansett. Center for Atmospheric Chemistry Studies.
For primary bibliographic entry see Field 5B.
W90-01251

**THEORY AND RESULTS FROM A QUASI-STEADY-STATE PRECIPITATION-SCAVENGING MODEL.**
Battelle Pacific Northwest Labs., Richland, WA.
For primary bibliographic entry see Field 5B.
W90-01252

**WATER CONTENT OF ATMOSPHERIC AEROSOLS.**
California Inst. of Tech., Pasadena. Environmental Quality Lab.
C. Pilinis, J. H. Seinfeld, and D. Grosjean.
Atmospheric Environment ATENBP, Vol. 23, No. 7, p 1601-1606, July 1989.

Descriptors: *Acid rain, *Atmospheric water, *Path of pollutants, *Precipitation, *Aerosols, Water content, Particulate phase, Water chemistry.

The water content of atmospheric aerosol particles is calculated, both above and below the classic deliquescent point. The existence of water in the particulate phase is predicted to be strongly dependent on the aerosol composition. Liquid water in the particulate phase is predicted to be strongly dependent on the aerosol composition. Liquid water may constitute a significant mass fraction of the aerosol concentration at r.h. < 60%. Using thermodyamic arguments, the hysteric behavior has been studied and upper and lower bounds of the aerosol water concentrations in the supersaturated region can be predicted. (Author's abstract)
W90-01253

**ISOTOPIC VARIABILITY OF RAIN ON A ONE HECTARE PLOT (VARIABILITE ISOTOPIQUE D'UNE PLUIE A L'ECHELLE DE L'HECTARE).**
Centre de Recherches de Rennes (France).
P. Merot, C. Gascuel-Odoux, O. Quidu, and A. Simon.
Comptes Rendus de l'Academie des Sciences (Serie 2) CRASEV, Vol. 309, No. 2, p 227-232, June 15, 1989. 4 fig, 2 tab, 8 ref.

Descriptors: *Precipitation, *Variability, *Sampling, *Spatial distribution, *Stable isotopes, Kriging.

The spatial variability of isotope content in precipitation was estimated on a scale of one hectare. Thirty-nine samples were taken from a square grid on a plane natural meadow. The precipitation was collected in small vessels placed in the soil during a shower. Samples were refrigerated. The analyses were performed at two periods. Oxygen-18 analyses were made by a standard method, using a double collecting mass spectrometer. Statistical processing of the data was performed. Then the spatial correlation of the data was computed using geostatistics, and a map of the estimated values was built using kriging. The kriged isotope content is almost randomly distributed, the values range from -6.86 to -7.02 delta ppt; this variation corresponds to analytical precision. According to the results obtained for a single hectare plot and with an oceanic climate, two samples seem sufficient to characterize the isotopic content of precipitation. (Miller-PTT)
W90-01255

**RESOLUTION CONSIDERATIONS IN USING RADAR RAINFALL DATA FOR FLOOD FORECASTING.**
Waterloo Univ. (Ontario). Dept. of Chemical Engineering.
N. Kouwen, and G. Garland.
Canadian Journal of Civil Engineering CJCEB8, Vol. 16, No. 3, p 279-289, June 1989. 11 fig, 1 tab, 40 ref. Natural Sciences and Engineering Research Council of Canada Grant A7982.

Descriptors: *Radar, *Flood forecasting, *Hydrologic models, *Rainfall-runoff relationships, Simulation, Remote sensing, Ontario, Spatial resolution, Variability, Hydrographs, Gages.

The objectives of this study are: (1) to show the hydrological effects of changing the spatial resolution of radar-derived rainfall, and (2) to show the effect of discretization of radar data on hydrological modeling for flood forecasting. Simulated hydrographs are compared for 2, 5, and 10 km basin grid sizes for the Grand River watershed in Ontario. An eight-level discretization of rainfall is compared with a 256-level scale of rainfall intensities. Spatial averaging tends to reduce the effect of erroneous radar readings and give comparable results with those obtained using finer resolutions. A total of 30-50 grid elements appear to adequately model a basin for flow forecasting purposes, but the elements should not be so large that substantial variations in rainfall are lost. This limits the elements to approximately 10 x 10 km if floods are produced by thunderstorms or frontal systems. The level of discretization of radar precipitation data does not significantly affect the generation of hydrographs. Hydrographs based on the radar-derived rainfall generally reproduced measured hydrographs better than those derived from the rain gage data. (Author's abstract)
W90-01365

**STATISTICAL CHARACTERISTICS OF RADAR ECHOES OF PRECIPITATING SNOW CLOUDS OVER THE ISHIKARI BAY, HOKKAIDO, JAPAN.**
Hokkaido Univ., Sapporo (Japan). Dept. of Geophysics.
K. Kikuchi, and Y. Asuma.
Journal of the Meteorological Society of Japan MJSJAU, Vol. 67, No. 2, p 221-230, April 1989. 11 fig, 1 tab, 9 ref.

Descriptors: *Radar, *Clouds, *Precipitation, *Snow, *Japan, *Remote sensing, Atmospheric water, Weather, Weather data collection, Meteorological data collections, Monsoons.

The characteristics of radar echoes of the precipitating snow clouds over the Ishikari Bay, Hokkaido, Japan were investigated statistically during four months, February and March of 1983 and 1984. In this analysis, the precipitating snow clouds were divided into three types: typical monsoon, final period of monsoon type and low pressure type based on the daily weather maps. Examined elements in this analysis were as follows: size distributions of radar echo population, percentage occupied by the strong echo areas as against total precipitating echo areas, time changes of echo areas, locations of the center of individual large echo areas, lifetime of the echoes, etc. Highly interesting characteristics were obtained; log-normal distribution was obtained for the size ranges of radar echoes of all snowfall types; the percentage occupied by the echoes stronger than level 2 accounted for less than 40% of all echo areas; the total echo area showed sharp fluctuations; the locations at which the radar echo areas reached their maximal sizes when the snow clouds invaded the plain were along the coastline; and the average echo area having a lifetime of 1 hr was found to be approximately 25 sq km. (Author's abstract)
W90-01390

**EFFECT OF FOREST BIOMASS ON AIRBORNE SNOW WATER EQUIVALENT ESTIMATES OBTAINED BY MEASURING TERRESTRIAL GAMMA RADIATION.**
Arizona State Univ., Tempe. Dept. of Decision and Information Systems.
For primary bibliographic entry see Field 7B.
W90-01395

**QUALITY OF SATELLITE PRECIPITABLE WATER CONTENT DATA AND THEIR IMPACT ON ANALYZED MOISTURE FIELDS.**
European Centre for Medium Range Weather Forecasts, Reading (England).
For primary bibliographic entry see Field 7B.
W90-01396

**CLIMATIC CHANGE IN NIGERIA: VARIATION IN RAINFALL RECEIPT PER RAINDAY.**
Ilorin Univ. (Nigeria). Dept. of Geography.

O. J. Olaniran, and G. N. Sumner.
Weather WTHRAL, Vol. 44, No. 6, p 242-248, June 1989. 5 fig, 3 tab, 13 ref.

Descriptors: *Rainfall, *Precipitation, *Rainfall intensity, *Climates, *Nigeria, *Meteorological data collection, Weather data collections, Weather, Africa, Drought.

Mean rainfall intensity may be considered a convenient index of rainfall activity associated with rainfall generating features such as the Inter-Tropical Discontinuity (ITD) over West Africa. The mean rainfall intensity series in Nigeria was analyzed for periodicity, fluctuations and trend through the comparatively long period since about 1920 in most regions for which data are available. Significant negative lag-one serial correlations were obtained for the four series, using the power spectrum, suggesting that the mean rainfall intensity series for each region exhibits a highly marked oscillation. Results indicate that in the Guinea-Savanna zone, since the early 1970s, there has been a significant increase in rainfall intensities, and, over the century up to 1967, also in the Sahel. These regional variations emphasize that, very often, tends and fluctuations in rainfall totals are not necessarily matched by similar variations in rainfall intensity. There was, in addition, little correspondence between adjacent regions, on a year-to-year basis, in Nigeria, in terms of the pattern of intensity fluctuations through time, so that these changes in rainfall intensity would appear to have been identified over much of subtropical Africa in both hemispheres. The filtered series illustrate that there is sometimes broad agreement in the times of higher or lower rainfall intensities between regions. (Friedmann-PTT)
W90-01408

**EFFECTS OF THE LENGTH OF RECORD ON ESTIMATES OF ANNUAL AND SEASONAL PRECIPITATION.**
Nevada Univ. System, Las Vegas. Water Resources Center.
For primary bibliographic entry see Field 7C.
W90-01410

**SAHELIAN DROUGHT(S) AS SEEN FROM THE RAINFALL DATA OF A MAURITANIAN STATION.**
Institut Royal Meteorologique de Belgique, Brussels. Hydrology Section.
For primary bibliographic entry see Field 7B.
W90-01411

**SYSTEM FOR WEATHER-BASED ANALYSIS OF DROUGHT IN AFRICA.**
Agriculture Canada, Ottawa (Ontario). Soil and Climate Section.
For primary bibliographic entry see Field 7B.
W90-01412

**GENERATION OF SYNTHETIC RAINFALL SEQUENCES OF MULTIPLE STATIONS USING THE ANALYSIS OF VARIANCE MODEL.**
Universidade Federal da Paraiba, Campina Grande (Brazil). Dept. of Civil Engineering.
For primary bibliographic entry see Field 7C.
W90-01413

**PREDICTION OF CYCLIC RAINFALL AND STREAMFLOW.**
University of the Witwatersrand, Johannesburg (South Africa). Water Systems Research Programme.
W. A. J. Paling, and D. Stephenson.
IN: Computer Methods and Water Resources: First International Conference, Morocco, 1988. Vol. 3, Computational Hydrology. Computational Mechanics Publications, Boston. 1988. p 141-156, 5 fig, 16 ref.

Descriptors: *Model studies, *Stochastic models, *Rainfall forecasting, *Deterministic models, *Rainfall-runoff relationships, *Streamflow forecasting, *Hydrologic models, Catchment areas, Groundwater movement, Geohydrology, Probabilistic process, Streamflow, Climatic data, Drought, Hydrologic cycle.

A semi-deterministic method of estimating future rainfall and streamflow incorporating Tyson's cycles is presented. Streamflow components include climatic trend, long-term climatic cycles, seasonal variance, catchment response, groundwater contribution, and a random component. The latter stochastic element can be minimized by assessment and separation of the other effects. Short-term projections can generally be made accurately using catchment models. Longer term projections cab similarly be made accurately in drought conditions where catchment groundwater contribution is the overriding component. When rainfall occurs further ahead than the lag-time of the catchment, the probability of various flows can be established. 'Most probable' streamflow is estimated with greater certainty than when using a completely stochastic model if the deterministic elements are separated and evaluated. (See also W90-01409) (Author's abstract)
W90-01422

**STOCHASTIC METHODS AND RELIABILITY ANALYSIS IN WATER RESOURCES.**
Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
For primary bibliographic entry see Field 7C.
W90-01424

**MODEL OF VECTOR TIME SERIES WITH BINARY COMPONENTS FOR APPLICATIONS IN CLIMATOLOGY (SUR UN MODELE DE SERIE CHRONOLOGIQUE VECTORIELLE A COMPOSANTES BINNAIRES EN VUE D'APPLICATIONS EN CLIMATOLOGIE).**
Mohammed-5 Univ., Rabat (Morocco). Dept. de Mathematiques.
B. Essebbar, and A. LeBreton.
IN: Computer Methods and Water Resources: First International Conference, Morocco, 1988. Vol. 3, Computational Hydrology. Computational Mechanics Publications, Boston. 1988. p 199-217, 2 fig, 6 tab, 16 ref. No English summary.

Descriptors: *Model studies, *Mathematical models, *Climatology, *Time series analysis, *Mathematical analysis, Statistical analysis, Meteorology, Precipitation, France.

A model of vector time series with binary components is proposed for application to the modelling of climatological phenomenon of the succession of dry and wet days, during a given time of the year, in a set of meteorological stations. Subseries of the vector time series are defined by means of thinnings of a basic alternating renewal process in discrete time and their 'complementaries.' Properties of the model are analyzed and the experimental verification of the model is presented. The model was applied to a study of the climatology in southeastern France, in the cities of Marseille, Montpellier, Montelimar and Toulon. (See also W90-01409) (Peters-PTT)
W90-01425

**WATER RELEASE FROM A FORESTED SNOWPACK DURING RAINFALL.**
Pacific Southwest Forest and Range Experiment Station, Berkeley, CA.
For primary bibliographic entry see Field 2A.
W90-01457

**RATIOS OF EDDY TRANSFER COEFFICIENTS OVER THE AMAZON FOREST.**
Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
For primary bibliographic entry see Field 2D.
W90-01466

**INFLUENCE OF CLIMATE CHANGE AND CLIMATIC VARIABILITY ON THE HYDROLOGIC REGIME AND WATER RESOURCES.**
For primary bibliographic entry see Field 2A.
W90-01537

**ANALYSIS OF THE VARIATION TREND OF THE ANNUAL RUNOFF ON THE NORTHERN SLOPE OF QILIAN SHAN.**
Academia Sinica, Lanzhou (China). Lanzhou Inst. of Glaciology and Cryopedology.
For primary bibliographic entry see Field 2E.
W90-01540

**RAINFALL TRENDS IN WEST AFRICA, 1901-1985.**
Lagos Univ. (Nigeria). Dept. of Geography.
O. Ojo.
IN: The Influence of Climate Change and Climatic Variability on the Hydrologic Regime and Water Resources, International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication No. 168, 1987. p 37-43, 1 fig, 15 ref.

Descriptors: *Drought, *Rainfall variability, *Meteorological data collection, *Africa, Rainfall patterns, Climatology.

The characteristics of rainfall variations between 1901-1985 in West Africa is examined using instrumental records. Characteristics of rainfall, particularly periodicities and variabilities, emphasizing decadal, quinquennial and annual characteristics are discussed. Some hydroclimatologic consequences of climatic change and climatic variations are examined with respect to streamflow characteristics. It was observed that: (1) the present century began with a relatively long period of drought persistence (1900-1926). This was followed by a wet period (1927-1960); (2) the present drought conditions have been characteristically persistent since about 1961 and particularly since about 1965; (3) in spite of the above generalizations, no regular patterns can be observed in trends, periodicities and persistence of hydrologic consequences of rainfall variations to allow for predictability of these consequences relative to rainfall variations; and (4) because of the large spatial and temporal variations in the characteristics of rainfall, and the resulting hydroclimatologic consequences, there is urgent need to improve the availability and reliability of the data. (See also W90-01537) (Author's abstract)
W90-01541

**EVALUATION OF RUNOFF CHANGES IN THE LABE RIVER BASIN BY SIMULATING THE PRECIPITATION-RUNOFF PROCESS.**
Ceskoslovenska Akademie Ved, Prague. Hydrometeorological Inst.
For primary bibliographic entry see Field 2E.
W90-01543

**CLIMATIC FLUCTUATIONS AND RUNOFF FROM GLACIERISED ALPINE BASINS.**
Manchester Univ. (England). Dept. of Geography.
For primary bibliographic entry see Field 2E.
W90-01544

**SPATIAL AND TEMPORAL VARIABILITY OF RAINFALL AND POTENTIAL EVAPORATION IN TUNISIA.**
Lund Univ. (Sweden). Dept. of Water Resources Engineering.
R. Berndtsson.
IN: The Influence of Climate Change and Climatic Variability on the Hydrologic Regime and Water Resources, International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication No. 168, 1987. p 91-100, 6 fig, 1 tab, 14 ref.

Descriptors: *Rainfall variability, *Climatology, *Evapotranspiration potential, *Tunisia, Rainfall distribution, Spatial distribution, Temporal distribution.

Different aspects of mainly temporal and spatial variability of rainfall in Tunisia are presented and discussed. Long-term trends seem to follow a general pattern of consecutive dry or wet periods of 5 to 30 yrs. Spatial patterns of shorter rainfall series (annual, monthly) are governed mainly by topography and coastal influence. Short high-intensity

rainstorms occur with cellular patterns, with a typical cell size of about 6-7 sq km, cell size being defined as the area within the 0.7 correlation isoline. (See also W90-01537) (Author's abstract)
W90-01545

**CLIMATOLOGY OF DRY AND WET PERIODS OVER WESTERN CANADA IN A GENERAL CIRCULATION MODEL.**
Canadian Climate Centre, Downsview (Ontario).
For primary bibliographic entry see Field 2G.
W90-01546

**PALEOHYDROLOGIC STUDIES USING PROXY DATA AND OBSERVATIONS.**
Bundesanstalt fuer Gewaesserkunde, Koblenz (Germany, F.R.).
For primary bibliographic entry see Field 2A.
W90-01547

**VARIABILITY IN PERIODICITIES EXHIBITED BY TREE RING DATA.**
Purdue Univ., Lafayette, IN. School of Civil Engineering.
For primary bibliographic entry see Field 2A.
W90-01549

**LAKE ICE FORMATION AND BREAKUP AS AN INDICATOR OF CLIMATE CHANGE: POTENTIAL FOR MONITORING USING REMOTE SENSING TECHNIQUES.**
Cooperative Inst. for Research in Environmental Science, Boulder, CO.
For primary bibliographic entry see Field 2C.
W90-01551

**MASS BALANCE OF NORTH CASCADE GLACIERS AND CLIMATIC IMPLICATIONS.**
Maine Univ. at Orono. Inst. for Quaternary Studies.
For primary bibliographic entry see Field 2C.
W90-01552

**CRITICAL PRECIPITATION CONDITIONS FOR LANDSLIDE AND TREE RING RESPONSES IN THE ROKKO MOUNTAINS, KOBE, JAPAN.**
Kobe Univ. (Japan). Graduate School of Science and Technology.
For primary bibliographic entry see Field 2J.
W90-01554

**ROLE OF STOCHASTIC HYDROLOGY IN DEALING WITH CLIMATIC VARIABILITY.**
Geological Survey, Reston, VA.
For primary bibliographic entry see Field 2A.
W90-01555

**LONG WATER BALANCE TIME SERIES IN THE UPPER BASINS OF FOUR IMPORTANT RIVERS IN EUROPE--INDICATORS FOR CLIMATIC CHANGES.**
Service Hydrologique National, Bern (Switzerland).
For primary bibliographic entry see Field 2A.
W90-01556

**ANALYSIS OF PATTERNS IN A PRECIPITATION TIME SEQUENCE BY ORDINARY KALMAN FILTER AND ADAPTIVE KALMAN FILTER.**
Kyushu Univ., Fukuoka (Japan). Dept. of Hydraulic Civil Engineering.
A. Kawamura, K. Jinno, T. Ueda, and R. R. Medina.
IN: The Influence of Climate Change and Climatic Variability on the Hydrologic Regime and Water Resources, International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication No. 168, 1987. p 221-232, 5 fig, 2 tab, 7 ref.

Descriptors: *Rainfall variability, *Climatology, *Drought, *Precipitation, *Time series analysis, *Mathematical studies, Model studies, Japan.

A methodology of investigating the patterns in a precipitation time sequence by an ordinary Kalman filter (OKF) and an adaptive Kalman Filter (AKF) is proposed. This research aims to investigate the occurrence and characteristics of drought precipitation patterns. The methodology is applied to the 92-yr long monthly precipitation time sequence at Fukuoka City in Japan. OKF identifies the periods (in the time sequence) with abnormal precipitation by comparing the observed and average precipitation patterns. AKF detects the changes of the long term precipitation patterns in the time sequence. These changes are associated with the abrupt changes in the parameters of the periodic-stochastic model. The time sequence is divided into several precipitation epochs, where an epoch is uniquely represented by one set of parameter values. The precipitation pattern in ea epoch is appropriately characterized and reveals whether the risk of drought occurrence is high or not in an epoch. (See also W90-01537) (Author's abstract)
W90-01557

**IDENTIFICATION OF RECENT RAINFALL FLUCTUATIONS IN THE PHILIPPINES.**
Kyushu Univ., Fukuoka (Japan). Dept. of Hydraulic Civil Engineering.
R. R. Medina, K. Jinno, T. Ueda, and A. Kawamura.
IN: The Influence of Climate Change and Climatic Variability on the Hydrologic Regime and Water Resources, International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication No. 168, 1987. p 233-244, 4 fig, 2 tab, 10 ref.

Descriptors: *Rainfall variability, *Climatology, *Philippines, Mathematical analysis, Stochastic models, Time series analysis.

The identification of rainfall fluctuations as determined by whether the occurrence of a short-duration rainfall pattern anomaly will cause an abrupt change in rainfall characteristics--the rainfall characteristics within a period will be terminated by an instantaneous shift to another period with different rainfall characteristics--was studied. The approach was applied to the 1951-1983 monthly rainfall data of 4 stations representative of the 4 types of climates in the Philippines. The adaptive Kalman filter was used to identify fluctuations in a rainfall sequence by directly linking them with the abrupt changes in the parameters of the periodic-stochastic model of the rainfall time sequence. Fluctuations of 10% or more in the mean between non-overlapping adjacent periods were detected. However, the Chow test for parameter change has shown that the mean is still not sufficient to describe the rainfall fluctuations. (See also W90-01537) (Author's abstract)
W90-01558

**TEMPORAL DISAGGREGATION OF MONTHLY RAINFALL DATA FOR WATER BALANCE MODELLING.**
Hawaii Univ. at Manoa, Honolulu. Dept. of Geography.
T. W. Giambelluca, and D. S. Oki.
IN: The Influence of Climate Change and Climatic Variability on the Hydrologic Regime and Water Resources, International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication No. 168, 1987. p 255-267, 5 fig, 4 tab, 12 ref.

Descriptors: *Meteorology, *Climatology, *Hydrologic budget, *Model studies, Meteorological data collection, Groundwater recharge, Simulation analysis, Hawaii.

Water balance calculations using hourly, daily, and monthly intervals, rather than monthly intervals only, for a site in Hawaii resulted in recharge estimates of 40%, 37% and 19% of precipitation. For locations where daily rainfall data are unavailable, but for which daily rainfall characteristics may be estimated, a method is developed for simulating sequences of daily rainfall which equate with a known monthly total. Using this method for the Hawaii sample site, soil moisture, evapotranspiration, and recharge estimates were significantly improved over monthly based estimates. However, using the simulated data, recharge estimates were consistently about 23% lower than estimates based on hourly data. (See also W90-01537) (Author's abstract)
W90-01560

**SPACE-TIME MODELLING OF RAINFALL-RUNOFF PROCESS.**
Ottawa Univ. (Ontario). Dept. of Civil Engineering.
K. Adamowski, F. B. Mohamed, and N. R. Dalezios.
IN: The Influence of Climate Change and Climatic Variability on the Hydrologic Regime and Water Resources, International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication No. 168, 1987. p 269-280, 2 fig, 6 tab, 15 ref.

Descriptors: *Rainfall-runoff relationships, *Model studies, *Statistical methods, Parameter estimation, Ontario, Canada.

An explanatory model belonging to the class of space-time transfer function-noise (STTFN) processes is presented. A three-stage iterative procedure for building a STTFN model of the rainfall runoff process is developed. Four precipitation and runoff stations located in a watershed in Southern Ontario, Canada, sampled at 15-da intervals are used for the numerical analysis. The identified model is STTF (2,1,0,0,1,0,0). The model parameters are estimated by the polytope method, the optimal-step steepest descent method, a conjugate gradient method, and a quasi-Newton method. The developed space-time model proved to be adequate in describing the spatio-temporal characteristics of precipitation and runoff time series. (See also W90-01537) (Author's abstract)
W90-01561

**MODELING A NON-STATIONARY PROCESS--APPLICATION TO THE RAINFALL DATA IN SEMI-ARID AREAS, (MODELISATION D'UN PROCESSUS NON-STATIONNAIRE--APPLICATION A LA PLUVIOMETRIE EN ZONE SEMI-ARIDE).**
Ecole Polytechnique Federale de Lausanne (Switzerland). Inst. de Genie Rural.
For primary bibliographic entry see Field 7C.
W90-01563

**IMPACT OF CLIMATE CHANGE ON THE MORPHOLOGY OF RIVER BASINS.**
For primary bibliographic entry see Field 2E.
W90-01565

**IMPACTS OF ALTERNATING FLOOD AND DROUGHT-DOMINATED REGIMES ON CHANNEL MORPHOLOGY AT PENRITH, NEW SOUTH WALES, AUSTRALIA.**
Sydney Univ. (Australia).
For primary bibliographic entry see Field 2E.
W90-01566

**IS THE LARGEST NORTH AMERICAN SUB-ARCTIC SAND DUNE DISAPPEARING.**
Saskatchewan Research Council, Saskatoon.
For primary bibliographic entry see Field 2J.
W90-01567

**DROUGHT, RUNOFF AND SURFACE WATER RESOURCES--EFFECTS ON SMALL WATERSHEDS IN BURKINA FASO (SECHERESSE, DESERTIFICATION ET RESSOURCES EN EAU DE SURFACE--APPLICATION AUX PETITS BASSINS DU BURKINA FASO).**
Office de la Recherche Scientifique et Technique Outre-Mer, Montpellier (France). Lab. d'Hydrologie.
J. Albergel.
IN: The Influence of Climate Change and Climatic Variability on the Hydrologic Regime and Water Resources, International Association of Hydrological Sciences Press, Institute of Hydrology, Wal-

lingford, Oxfordshire, UK. IAHS Publication No. 168, 1987. p 355-365, 8 fig, 3 tab, 14 ref. English summary.

Descriptors: *Rainfall variability, *Climatology, *Africa, *Drought, *Watersheds, *Rainfall-runoff relationships, *Model studies, Runoff, Watershed management, Soil, Land use.

A chronological succession of runoff events was built in order to study the effect of the drought on the runoff of small watersheds in sahelian Africa. A specific rainfall-runoff model was derived based on the mapping of superficial soil features and on the related rainfall-runoff relationships derived from rainfall simulation experiments. It was applied to two small catchments (22 and 54 sq km) in Burkina Faso. Superficial soil features have evolved along with natural climatic changes and with changes in land use. The runoff time series obtained for the humid period 1950-1968 and for the dry period 1969-1984 were compared. In the dry period, more favorable conditions for runoff make up for the rainfall deficit, so that globally the runoff distribution remains unchanged. A strong rainfall which had the same probability of occurence in the two periods produced a larger flood. (See also W90-01537) (Author's abstract)
W90-01568

**GLACIAL AND HYDROLOGICAL REGIME UNDER CLIMATIC INFLUENCE IN THE URUMQI RIVER, NORTHWEST CHINA.**
Academia Sinica, Lanzhou (China). Lanzhou Inst. of Glaciology and Cryopedology.
T. Yao.
IN: The Influence of Climate Change and Climatic Variability on the Hydrologic Regime and Water Resources, International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication No. 168, 1987. p 367-377, 4 tab, 12 ref.

Descriptors: *Rainfall variability, *Climatology, *China, *Glaciers, Hydrologic cycle, Climates, Mass balances, Fluctuations, Discharge, Frequency.

The influence of glacial and hydrologic fluctuations and their distinct climatic features on the Urumqi River are analyzed. The galcial and hydrologic fluctuations in the Umrumqi River have the same pattern in which high discharge and positive mass balance periods are mainly identical with positive mass balance periods are mainly identical with cold periods; low discharge and negative mass balance periods are identical with warm peiods. A particular temperature-wetness pattern, which could be explained by prevailing general atmospheric circulation patterns is responsible for the pattern. Distinct features between glacier and discharge under climatic influence are distinguished. Glacial terminal fluctuates as a slow process with low frequency while discharge fluctuates as a rather fast process with high frequency in the basin, which results from the time lag difference between glacier and discharge responding to climatic fluctuation. (See also W90-01537) (Author's abstract)
W90-01569

**PRIMARY STUDY OF THE RELATIONSHIP BETWEEN GLACIAL MASS BALANCE AND CLIMATE IN THE QILIAN MOUNTAIN TAKING 'JULY FIRST' GLACIER AS AN EXAMPLE.**
Academia Sinica, Lanzhou (China). Lanzhou Inst. of Glaciology and Cryopedology.
For primary bibliographic entry see Field 2C.
W90-01570

**GLOBAL CLIMATIC CHANGES AND REGIONAL HYDROLOGY: IMPACTS AND RESPONSES.**
California Univ., Berkeley. Energy and Resources Group.
For primary bibliographic entry see Field 2A.
W90-01571

**IMPACTS OF CO2-INDUCED CLIMATE CHANGE ON HYDRO-ELECTRIC GENERATION POTENTIAL IN THE JAMES BAY TERRITORY OF QUEBEC.**
Montreal Univ. (Quebec).
For primary bibliographic entry see Field 4C.
W90-01572

**MACROSCALE HYDROLOGIC MODELS IN SUPPORT TO CLIMATE RESEARCH.**
Institut fuer Wasserwirtschaft, Berlin (German D.R.).
For primary bibliographic entry see Field 2A.
W90-01574

**SPATIAL AND TEMPORAL VARIABILITY OF THE WATER BALANCE OF SOME WATERSHEDS IN WESTERN AFRICA IN RELATION TO CLIMATIC CHANGES (VARIABILITE SPATIALE ET TEMPORELLE DES BILANS HYDIPUES DE QUELQUES BASSINS VERSANTS D'AFRIQUE DEL'OUEST EN LIAISON AVEC LES CHENGEMENTS CLIMATIQUES).**
Office de la Recherche Scientifique et Technique Outre-Mer, Montpellier (France). Lab. d'Hydrologie.
For primary bibliographic entry see Field 2A.
W90-01575

**CLIMATIC CHANGE AND GREAT LAKES WATER LEVELS.**
Windsor Univ. (Ontario). Great Lakes Inst.
M. Sanderson, and L. Wong.
IN: The Influence of Climate Change and Climatic Variability on the Hydrologic Regime and Water Resources, International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication No. 168, 1987. p 477-487, 6 fig, 3 tab, 14 ref.

Descriptors: *Greenhouse effect, *Great Lakes, *Climatology, *Global warming, *Carbon dioxide, Model studies, Temperature, Water level, Flow, Future planning, Consumptive use.

World climatologists believe that increasing concentrations of CO2 in the earth's atmosphere will result in significant changes in the world's climate during the next century. The predictions of monthly temperature and precipitation for the Great Lakes basin derived from a current General Circulation (climatic change) Model, are incorporated into a hydrologic model of the Great Lakes to predict future levels and flows under 2 x CO2 conditions. The analysis resulted in the production of three scenarios of Great Lakes levels and flows. The first, gives the levels and flows which would have occurred during 1900-1976 under current diversions, regulation practices and physical conditions of the lakes and connecting channels. This scenario reflects the influence of climate alone on levels and flows in the Great Lakes. The average ranges in lake levels vary from 1 m for Lake Superior to 2.14 m for Ontario. Scenario 2 indicates that under 2 times CO2 conditions mean lake levels will drop slightly for lakes Superior, Michigan, Huron, and Erie. Senario 3 includes the impact of future increased consumptive use in addition to climatic change and predicts a small change in the level and outflow of Lake Superior and a mean level of Michigan-Huron decrease of 80 cm and Erie of 70 cm. (See also W90-01537) (White-Reimer-PTT)
W90-01577

**SENSITIVITY OF WATER RESOURCES IN THE GREAT LAKES REGION TO CHANGES IN TEMPERATURE, PRECIPITATION, HUMIDITY, AND WIND SPEED.**
Canadian Climate Centre, Downsview (Ontario).
S. J. Cohen.
IN: The Influence of Climate Change and Climatic Variability on the Hydrologic Regime and Water Resources, International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication No. 168, 1987. p 489-499, 6 tab, 14 ref.

Descriptors: *Rainfall variability, *Greenhouse effect, *Climatology, *Global warming, *Great Lakes, Future planning, Soil moisture, Water level, Water yield, Temperature, Precipitation, Humidity, Wind.

Scenarios of global climatic warming ('Greenhouse Effect'), based on atmospheric models, historical analogues, and hypothetical cases, were used to determine the sensitivity of Great Lakes water resources to changes in several climatic elements. Results tend to confirm earlier studies that climatic warming would lead to decreases in net basin supply and soil moisture. However when original temperature and precipitation scenarios were modified by changes in humidity and wind speed, results changed significantly, indicating the importance of lake evaporation to net basin supply in this region. More research is needed in deriving regional wind and humidity scenarios within the context of global climate warming. (See also W90-01537) (Author's abstract)
W90-01578

**PERSISTENT CONSEQUENCES OF THE PRESENT DROUGHT ON THE FLOWS OF THE SENEGAL RIVER AND THE HYPERSALINISATION OF THE LOWER CASAMANCE (LES CONSEQUENCES DURABLES DE LA SECHERESSE ACTUELLE SUR L'ECULEMENT DU FLEUVE SENEGAL ET L'HYPERSALINISATION DE LA BASSE-CASAMANCE).**
Office de la Recherche Scientifique et Technique Outre-Mer, Paris (France).
J. C. Olivry.
IN: The Influence of Climate Change and Climatic Variability on the Hydrologic Regime and Water Resources, International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication No. 168, 1987. p 501-512, 6 fig, 1 tab, 11 ref. English summary.

Descriptors: *Drought, *Sahel, *Climatology, *Rainfall variability, *Groundwater depletion, *Saline water intrusion, *Senegal River, Evaporation, Hydrological regime.

In Sahelian and Sudanese regions, the persistent consequences of the present drought differentiate it from other dry spells of the 20th century. Two investigations carried out in Senegal showed the part of a major depletion of groundwater storage. After the annual flood, the hydrographs of the Senegal River showed discharges falling off exponentially according to a depletion coefficient without a large change during 70 yrs (mean value: a = 0.0186/d). This trend has been altered over the present drought showing an increasingly rapid decline (a = 0.038/d in 1984). Marine intrusion and tidal influences characterize the Lower Casamance. In dry season, until 1973, salinity decreased going upstream (maximum < 35%). Actually, the salinisation gradient has become positive going upstream (maximum > 150%) because evaporation is not compensated by groundwater reserves which are almost completely depleted. The more abundant rainfalls in 1984-85 did not reverse this trend. These examples demonstrate that even if climatologic conditions improve, the return of former hydrologic regimes will not be immediate. It will require the reconstitution of groundwater reserves (several wet yrs without further dry spells). (See also W90-01537) (Author's abstract)
W90-01579

**EFFECT OF CLIMATE CHANGES ON THE PRECIPITATION PATTERNS AND ISOTOPIC COMPOSITION OF WATER IN A CLIMATE TRANSITION ZONE: CASE OF THE EASTERN MEDITERRANEAN SEA AREA.**
Weizmann Inst. of Science, Rehovoth (Israel). Dept. of Isotope Research.
J. R. Gat, and I. Carmi.
IN: The Influence of Climate Change and Climatic Variability on the Hydrologic Regime and Water Resources, International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication No. 168, 1987. p 513-523, 6 fig, 21 ref.

Descriptors: *Paleohydrology, *Paleoclimatology, *Rainfall variability, *Mediterranean Sea, *Weather patterns, *Climatology, *Precipitation, Isotopic composition, Temperature, Humidity.

In a climatic transition zone such as the Eastern Mediterranean Sea area, in which storm tracks and moisture origin is quite varied, the most important cause for a shift in the isotopic composition of meteoric waters appears to be a modification in the weighting factor in the annual average for each contributing synoptic pathway (each with its distinct isotopic signature). Changes in local meteorologic parameters affect the isotopic composition of rain only to a limited extent, with rain intensity as the most effective parameter. The effects of global temperature and humidity changes express themselves primarily by means of the 'd'--excess parameters (Deuterium excess). All-in-all, the reduced role of the Mediterranean Sea as a dominant vapor source for the region's precipitation in the past, appears to be the dominant factor in the change of isotopic composition between present-day precipitation and the paleowaters of the Levant. (See also W90-01537) (Author's abstract)
W90-01580

**CLIMATIC VARIABILITY AND REGOLITH GROUNDWATER REGIME IN SOUTHWESTERN NIGERIA.**
Ife Univ. (Nigeria). Dept. of Geography.
E. O. Omorinbola.
IN: The Influence of Climate Change and Climatic Variability on the Hydrologic Regime and Water Resources, International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication No. 168, 1987. p 525-534, 4 fig, 3 tab, 23 ref.

Descriptors: *Nigeria, *Climatology, *Groundwater potential, *Water table fluctuations, Wells, Mathematical analysis, Regression analysis, Rainfall variability.

The regolith groundwater regime in the Basement Complex of southwestern Nigeria and its spontaneous response to the variability of the prevailing humid tropical climate is illustrated. Similarity in degree of variability of rainfall and the groundwater regimes are observed. A highly significant inverse correlation between the mean monthly rainfall and the mean monthly depth to the water table, with a coefficient of about -0.80 and a relationship aptly described by simple linear regression equations, is noted. The monthly variation pattern of depth to the regolith groundwater table is optimally described by polynomial regression equations. The applicability of the study results is specified in respect to predicting mean depths to the water table at given points in time, determining groundwater level fluctuation rates by differential calculus, estimating the proportion of the available rainfall used in groundwater replenishment, and the correct timing of well-sinking operations so as to increase their success ratios and ensure adequate and perennial well yields. (See also W90-01537) (Author's abstract)
W90-01581

**LONG-TERM CHANGES IN WATER QUALITY PARAMETERS OF A SHALLOW EUTROPHIC LAKE AND THEIR RELATIONS TO METEOROLOGIC AND HYDROLOGIC ELEMENTS.**
Akademie der Wissenschaften der DDR, Berlin. Inst. fuer Geographie und Geooekologie.
For primary bibliographic entry see Field 2H.
W90-01582

**HYDROLOGIC DESIGN CRITERIA AND CLIMATE VARIABILITY.**
Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.
For primary bibliographic entry see Field 8A.
W90-01583

**METHODOLOGY FOR DISTINGUISHING BETWEEN THE EFFECTS OF HUMAN INFLUENCE AND CLIMATE VARIABILITY ON THE HYDROLOGIC CYCLE.**
Dansk Hydraulisk Inst., Hoersholm.
For primary bibliographic entry see Field 4C.
W90-01584

**IMPACT OF INCREASING ATMOSPHERIC CARBON DIOXIDE CONCENTRATIONS UPON RESERVOIR WATER QUALITY.**
Salford Univ. (England). Dept. of Mathematics and Computer Science.
B. Henderson-Sellers.
IN: The Influence of Climate Change and Climatic Variability on the Hydrologic Regime and Water Resources, International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication No. 168, 1987. p 571-576, 8 ref.

Descriptors: *Water quality, *Global warming, *Greenhouse effect, *Water temperature, *Carbon dioxide, *Reservoirs, Air-water interfaces, Water pollution, Model studies, Simulation analysis, Thermal stratification, Eddy diffusion, Heat storage.

The potential changes in a water body resulting from increasing atmospheric CO2 can be related to enhanced radiative and non-radiative fluxes (especially evaporation) at the air-water interface. The initial perturbation due to enhanced CO2 levels can be parameterized as an increase in the downwelling longwave radiative flux expressed as a function of time and CO2 concentration (the so-called 'transient' CO2 experiment'). The only experiments presented to date relating to the impact CO2 levels have on water resources have concentrated on the oceanic environment using simple box-diffusion models--models which cannot take into account seasonal and daily changes in water temperature and the consequent non-linear effects of heat storage that occur. To investigate these non-linear effects, an eddy diffusion thermal stratification model, which includes specification of all the meteorologic variables on timescales of 1-24 hrs, has been used to investigate further the impact of rising atmospheric CO2 concentrations on the aquatic environment. For a simulation period of 50 yrs, the net decrease in reservoir levels is found to be 2.05 m. If, simultaneously, stream inflow rates increase, this is likely to result in enhanced nutrient loading and accelerated eutrophication. (See also W90-01537) (Author's abstract)
W90-01585

**SOME POSSIBLE IMPACTS OF GREENHOUSE GAS INDUCED CLIMATIC CHANGE ON WATER RESOURCES IN ENGLAND AND WALES.**
University of East Anglia, Norwich (England). Climatic Research Unit.
J. P. Palutikof.
IN: The Influence of Climate Change and Climatic Variability on the Hydrologic Regime and Water Resources, International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication No. 168, 1987. p 585-596, 5 fig, 2 tab, 18 ref.

Descriptors: *Climatology, *England, *Wales, *Global warming, *Greenhouse effect, *Carbon dioxide, Evapotranspiration, River flow, Water resources, Temperature.

Two methods are employed to derive scenarios of runoff changes in 10 drainage basins in England and Wales due to increasing atmospheric concentrations of the greenhouse gases. The first method compares reconstructed riverflow data for the warmest and coldest 20-yr periods this century. It suggests riverflow will decrease in southern England and Wales and increase in northern areas. The second method attempts to introduce the direct effects of CO2 on plant transpiration into the analysis. In this scenario riverflow could be expected to increase throughout the country. The implications for water resources in England of increasing atmospheric concentrations of the greenhouse gases appear to be severe if only the climate changes are considered. The largest declines in riverflow will occur in the drier south where consumption is gradually rising. In the wetter northern areas the predicted increases in riverflow are of little significance since water use is actually declining. The picture changes dramatically once the possible direct effects of increasing CO2 are taken into account. If these lead to only a 15% reduction in evapotranspiration, the rainfall changes predicted will be accompanied by an increase in riverflow rather than any decline. (See also W90-01537) (Author's abstract)
W90-01586

**HYDROLOGIC RESPONSE TO AN ARTIFICIAL CLIMATIC CHANGE OF RAINFALL ENHANCEMENT.**
Ministry of Agriculture, Jerusalem (Israel). Hydrological Service.
A. Ben-Zvi, and M. Langerman.
IN: The Influence of Climate Change and Climatic Variability on the Hydrologic Regime and Water Resources, International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication No. 168, 1987. p 607-617, 1 fig, 5 tab, 13 ref.

Descriptors: *Greenhouse effect, *Global warming, *Israel, *Climatology, *Cloud seeding, *Rainfall, Flow augmentation, History, Nonparametric tests, Statistical analysis, Regression analysis, Resources management.

The effect of an artificial climatic change on the flow towards a lake is detected and estimated through a comparison of historical records. The change is generated by the cloud seeding operations in Northern Israel. The yardstick for the comparison is the depth of the rainfall at the control area for the seeding. The estimated effect of exogenic man-made changes is included in the comparison. The change is detected by a comparison of statistical parameters and through a nonparametric test. The magnitude of the change is estimated by a cross application of linear regression models. The annual flow volume is found to increase by 9%, of which 5% is attributed to the result of climatic fluctuations. The increase is not significant statistically, but from other research stages it is concluded that a change in the rainfall and in the flow does exist. Therefore, for water resources management purposes it is recommended that 3% of the total flow be attributed to the effect of the rainfall enhancement operations. (See also W90-01537) (Author's abstract)
W90-01588

**WILL CLOUDS PROVIDE A NEGATIVE FEEDBACK IN A CO2-WARMED WORLD.**
Liverpool Univ. (England). Dept. of Geography.
K. McGuffie, and A. Henderson-Sellers.
IN: The Influence of Climate Change and Climatic Variability on the Hydrologic Regime and Water Resources, International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication No. 168, 1987. p 619-628, 2 fig, 38 ref. USAF grant AFOSR-86-0118.

Descriptors: *Greenhouse effect, *Climatology, *Global warming, *Carbon dioxide, *Clouds, Cloud cover, Cloud physics, Temperature, Model studies.

Cloud cover records for western Europe, the continental United States and the Indian sub-continent have been analyzed in the context of a warming world historical analogue model. It is found that cloud cover has generally increased between the coldest and warmest years this century in each of these 3 climatologically diverse areas. This result seems to be at variance with the few available climate model predictions which suggest reduced cloud amounts. The degree of cloud amount change is roughly the same although the sign is opposite from that given in model simulations. The real world cloud results may indicate, assuming other cloud properties remain approximately constant, a tendency to reduce initially warmed surface temperatures, i.e. the cloud changes could provide a negative feedback effect for the climate. (See also W90-01537) (Author's abstract)
W90-01589

**REMOTE SENSING OF WATERSHED CHARACTERISTICS AND RAINFALL INPUT.**
Ruhr Univ., Bochum (Germany, F.R.).
For primary bibliographic entry see Field 7B.
W90-01601

**INFLUENCE OF THE METHOD FOR EFFECTIVE RAIN DETERMINATION ON THE PARAMETERS OF NASH MODEL FOR URBANIZED WATERSHED.**
Agricultural Univ. of Warsaw (Poland).
K. Banasik, A. Byczkowski, and S. Ignar.
IN: Hydrological Processes and Water Management in Urban Areas. Proceedings of the International Symposium 24-29 April 1988, Duisburg, West Germany. International Hydrological Programme of UNESCO Publication, 1988. p 17-22, 2 tab, 7 ref.

Descriptors: *Rainfall intensity, *Nash model, *Rainfall-runoff relationships, *Urban watersheds, *Model studies, Hydrologic models, Flood hydrographs.

This paper describes practical applications of a conceptual model developed by Nash for rainfall-runoff transformation. Parameters N (number of reservoirs) and K (retention coefficient for single reservoir) for applied models were determined by using the method of moments, for four methods of effective rain evaluation. Parameter values determined from recorded data on rainfall and runoff for five flood hydrographs in small urban watersheds showed substantial differences for the methods used, with relatively small differences between recorded and observed hydrographs. (See also W90-01612) (Author's abstract)
W90-01613

**BLIZZARD INFORMATION SYSTEM AND SNOWING COUNTRY INFORMATION SYSTEM ( IN JAPANESE).**
For primary bibliographic entry see Field 7B.
W90-01733

**STUDY OF CATIONS IN THE PRECIPITATION OF ESTACAO ANTARTICA COMANDANTE FERRAZ (ESTUDO DE CATIONS NA PRECIPITACAO ANTARTICA ESTACAO COMANDANTE FERREZ).**
Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
For primary bibliographic entry see Field 2K.
W90-01780

**VARIATIONS OF TROPICAL CIRCULATION AND ASSOCIATED RAINFALL ANOMALIES, DURING 2 YEARS OF CONTRAST (VARIACOES DAS CIRCULACOES TROPICALS E AS ANOMALIAS DE PRECIPITACAO ASSOCIADAS, EM DOIS ANOS DE CONTRASTE).**
Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
M. T. Kayano.
Available from National Technical Information Service, Springfield, VA 22161 as N88-16286/2/GAR, Price codes: A08 in paper copy, A01 in microfiche. Report NIPE-4359-TDL/300, September 1987. 171p, 57 fig, 6 tab, 111 ref, 3 append. English summary.

Descriptors: *Climatology, *Meteorology, *Precipitation, *Drought, Tropical regions, *Wind, Walker circulation, Seasonal variation, Monsoons, Southern Oscillation, Atmospheric water vapor.

During 1983 severe droughts were observed over large ares of tropical lands and above normal rainfall over the equatoral central Pacific related to the 1982 to 1983 El Nino, while during 1984 the precipitation pattern was almost reversed. The analysis of the vertical velocity, calculated using observed wind, for 1983 and 1984, showed that the intensities and locations of ascending and descending branches of the Walker circulation were consistent with the anomalous precipitation distribution. The north-south ITCZ migration played an important role in modulating the tropical precipitation, during 1983 and 1984. The return from the El Nino circulation features to a normal pattern seems to have started around May 1983. Seasonal changes, such as the establishment of the summer monsoon regime over the Indian Ocean and India, contributed to this return. A highly significant correlation was verified between the Southern Oscillation Index (SOI) and the atmospheric water vapor. These calculations showed negative correlations for the central Pacific stations and positive correlations for the Indonesian stations, suggesting that the water vapor variations over these regions are modulated by the Southern Oscillation. The water vapor fluctuations are synchronized to the changes of the low level divergence field, such that an increase (decrease) of the convergence causes an increase (decrease) of water vapor content. (Author's Abstract)
W90-01782

**LARGE SCALE EFFECTS OF SEASONAL SNOW COVER.**
For primary bibliographic entry see Field 2C.
W90-01850

**LARGE SCALE EFFECTS OF SEASONAL SNOW COVER.**
Illinois Univ. at Urbana-Champaign. Dept. of Atmospheric Sciences.
For primary bibliographic entry see Field 2C.
W90-01851

**SNOW COVER AS AN INDICATOR OF CLIMATE CHANGE.**
Lamont-Doherty Geological Observatory, Palisades, NY.
For primary bibliographic entry see Field 2C.
W90-01852

**SNOW COVER--ATMOSPHERIC INTERACTIONS.**
Nebraska Univ., Lincoln. Dept. of Geography.
For primary bibliographic entry see Field 2C.
W90-01853

**SEASONAL VARIATION OF EURASIAN SNOW COVER AND ITS IMPACT ON THE INDIAN SUMMER MONSOON.**
Nairobi Univ. (Kenya). Dept. of Meteorology.
For primary bibliographic entry see Field 2C.
W90-01855

**STATISTICAL STUDIES OF THE ATMOSPHERIC CIRCULATION OF THE NORTHERN HEMISPHERE, HYDROCLIMATIC REGIMES IN CHINA AND ANTARCTIC ICE-SNOW COVER.**
Academia Sinica, Beijing (China). Inst. of Geography.
For primary bibliographic entry see Field 2C.
W90-01856

**INTERACTIONS BETWEEN THE SNOW COVER AND THE ATMOSPHERIC CIRCULATIONS IN THE NORTHERN HEMISPHERE.**
Tsukuba Univ. (Japan). Inst. of Geoscience.
For primary bibliographic entry see Field 2C.
W90-01857

**ESTIMATES OF POSSIBLE VARIATIONS OF SNOWMELT-RUNOFF CHARACTERISTICS ON CLIMATIC CHANGES.**
Akademiya Nauk SSSR, Moscow. Inst. Vodnykh Problem.
For primary bibliographic entry see Field 2C.
W90-01862

**RECONSTRUCTING MASS-BALANCE PROFILES FROM CLIMATE FOR AN ARCTIC ICE CAP.**
National Center for Atmospheric Research, Boulder, CO.
For primary bibliographic entry see Field 2C.
W90-01902

**ROLE OF LARGE-SCALE ICE SHEETS IN CLIMATE HISTORY.**
Bonn Univ. (Germany, F.R.). Meteorologisches Inst.
For primary bibliographic entry see Field 2C.
W90-01906

**GLACIAL ISOSTASY AND THE ICE AGE CYCLE.**
Toronto Univ. (Ontario). Dept. of Physics.
For primary bibliographic entry see Field 2C.
W90-01907

## 2C. Snow, Ice, and Frost

**ENGLACIAL AND SUBGLACIAL HYDROLOGY: A QUALITATIVE REVIEW.**
Norges Vassdrags- og Elektrisitetsvesen, Oslo.
R. L. Hooke.
Arctic and Alpine Research ATLPAV, Vol. 21, No. 3, p 221-233, August 1989. 7 fig, 53 ref.

Descriptors: *Glaciohydrology, *Glacial streams, *Glaciers, Ice pressure, Flow pattern, Flow discharge, Water pressure, Theoretical analysis, Drainage patterns, Drainage systems, Conduits, Valley streams, Ice, Overburden, Contours, Glacial sediments.

Modern interest in water flow through glaciers can be dated from a pair of theoretical papers published in 1972. In one of these the influence of ice pressure on the direction of water flow through and under glaciers is examined, and in the other a theoretical model is presented for calculating water pressures in subglacial conduits. Through a combination of these theoretical considerations and field observations, it is concluded that the englacial drainage system probably consists of an arborescent network of passages. The millimeter-sized finger-tip tributaries of this network join downward into ever larger conduits. Locally, moulins provide large direct connections between the glacier surface and the bed. Beneath a valley glacier the subglacial drainage is likely to be in a tortuous system of linked cavities transected by a few relatively large and comparatively straight conduits. The average flow direction in the combined system is controlled by a combination of ice-overburden pressure and bed topography, and in general is not normal to contours of equal elevation on the bed. Although theoretical studies usually assume that subglacial conduits are semicircular in cross section, there are reasons for believing that this ideal is rarely realized in nature. Broad low conduits may be the rule. When a glacier is moving over a bed of unconsolidated sediment, some water may drain through the sediment. In addition, when high water pressures weaken the sediment, it may be squeezed into subglacial channels, blocking them. (Author's abstract)
W90-01337

**PRESENT CLIMATE AND GLACIATION OF WESTERN MONTANA, U.S.A.**
Montana State Univ., Bozeman. Dept. of Earth Sciences.
W. W. Locke.
Arctic and Alpine Research ATLPAV, Vol. 21, No. 3, p 234-244, August 1989. 7 fig, 5 tab, 53 ref.

Descriptors: *Meteorology, *Montana, *Glaciation, *Snowpack, *Glaciers, Regression analysis, Monitoring, Seasonal variation, Elevation, Altitude, Latitudinal studies, Precipitation, Cirques, Wind, Moisture, Radiation, Temperature effects.

In western Montana the presence of active weather stations, snowpack monitoring sites, and modern glaciers allows the regionalization of summer temperature and winter precipitation data through trend surface analysis, and their comparison to the location of modern glaciers and the morphology of their cirques. Summer temperatures at 71 sites are well explained (80%) by a trend surface based on altitude, longitude, and latitude. In contrast, winter precipitation at 261 sites shows coherent residuals to a weaker (65%) regression on those variables. The residuals show the importance of local wind-

flow and regional moisture sources in controlling precipitation. A trend surface on equilibrium-line altitudes (ELAs) of 88 modern cirque glaciers explains 92% of the variance with latitude and longitude alone. Cool moist air, as recognized in the climatic data, controls present glacier elevations. The residuals to the trend reflect control of cirque glacier elevation by local windflow (7-64%), cirque orientation (20-30%), and backwall height (0-60%). Glaciers in Montana persist at higher summer temperatures for a given winter precipitation than most glaciers worldwide, a difference which can be explained by the minimal longwave radiation inputs and sensible heat available from warm, but dry continental air. Regression of ELAs against the estimated temperature/precipitation relationship yields consistent residuals which can be explained in part (13-36%) by cirque orientation and backwall height. (Author's abstract)
W90-01338

**MODELS OF THE DEVELOPMENT OF SNOW MANTLE AND OF SNOWMELT (MODELES D'EVOLUTION DU MANTEAU NIVAL ET DE LA FONTE DES NEIGES).**
Hydro-Quebec, Montreal. Service Production.
S. Bennis, and P. Brunelle.
Canadian Journal of Civil Engineering CJCEB8, Vol. 16, No. 3, p 219-226, June 1989. 10 fig, 1 tab, 10 ref. English summary.

Descriptors: *Snow mantle, *Snow, *Model studies, Snowmelt, Quebec, Snowmelt runoff model, Temperature, Precipitation, Density, Water depth.

The predictive snowmelt runoff model (SRM), is reliable and easy to use. Furthermore, the only parameters required are temperature and precipitation, and density and thickness of the snow pack. The literature available indicates that simulation results with this model are generally satisfactory. However, data on the extent of the snow cover are not always available; this means that the snow pack must be calculated before the SRM can be used. The model developed here evaluates the snowpack, and can be used in conjunction with the SRM. The SRM was modified in that maximum daily temperature was used instead of the number of degree-days. The snowmelt and snow cover models were calibrated and tested along the drainage basin of the Eaton River, a tributary of the Saint-Francois River in the province of Quebec. (Author's abstract)
W90-01362

**REVISED GROUND SNOW LOADS FOR THE 1990 NATIONAL BUILDING CODE OF CANADA.**
Canadian Climate Centre, Downsview (Ontario).
M. J. Newark, L. E. Welsh, R. J. Morris, and W. V. Dnes.
Canadian Journal of Civil Engineering CJCEB8, Vol. 16, No. 3, p 267-278, June 1989. 5 fig, 2 tab, 25 ref.

Descriptors: *Snow, *Snow depth, *Building codes, *Canada, *Snow loads, Elevation, Model studies, Snowpack, Gumbel extreme value distribution.

The last systematic recalculation of ground snow loads in the Supplement to the National building Code of Canada was made in 1977 and used data up to 1975. Data from three times as many stations are now available and there is also an additional 10 years of record. Using this expanded data base, ground snow loads have been recalculated for the 1990 supplement. Several changes in methods have been utilized, the most significant of which is the use of an objective technique to estimate ground snow loads at Code (or other) locations. It explicitly incorporates an assumed dependence of the snow load on topographical elevation, and accounts for the magnitude of errors at snow depth observation sites. Other differences include: (a) the use of the method of moments to fit the Gumbel extreme value distribution for the purpose of estimating the 30-year return period snow depth; (b) the use of geographically varying snow pack densities; and (c) using probabilistic rain components of the total snow load and estimating this component by use of a snow pack model. Results show an average decrease of 6.6% in the 1990 loads compared with those in the 1985 Supplement. A regional exception is in the Northwest Territories where the use of a greater snow density has led to an average increase of about 16% in the loads. A reduction in the standard deviation about the mean load suggests a more spatially consistent set of values for the 1990 Supplement. (Author's abstract)
W90-01364

**STATISTICAL CHARACTERISTICS OF RADAR ECHOES OF PRECIPITATING SNOW CLOUDS OVER THE ISHIKARI BAY, HOKKAIDO, JAPAN.**
Hokkaido Univ., Sapporo (Japan). Dept. of Geophysics.
For primary bibliographic entry see Field 2B.
W90-01390

**EFFECT OF FOREST BIOMASS ON AIRBORNE SNOW WATER EQUIVALENT ESTIMATES OBTAINED BY MEASURING TERRESTRIAL GAMMA RADIATION.**
Arizona State Univ., Tempe. Dept. of Decision and Information Systems.
For primary bibliographic entry see Field 7B.
W90-01395

**WATER RELEASE FROM A FORESTED SNOWPACK DURING RAINFALL.**
Pacific Southwest Forest and Range Experiment Station, Berkeley, CA.
For primary bibliographic entry see Field 2A.
W90-01457

**FOREST HARVEST, SNOWMELT AND STREAMFLOW IN THE CENTRAL SIERRA NEVADA.**
Pacific Southwest Forest and Range Experiment Station, Berkeley, CA.
For primary bibliographic entry see Field 4D.
W90-01458

**SNOW REDISTRIBUTION: STRIP CUTS AT YUBA PASS, CALIFORNIA.**
Pacific Southwest Forest and Range Experiment Station, Berkeley, CA.
For primary bibliographic entry see Field 4B.
W90-01459

**CLIMATIC FLUCTUATIONS AND RUNOFF FROM GLACIERISED ALPINE BASINS.**
Manchester Univ. (England). Dept. of Geography.
For primary bibliographic entry see Field 2E.
W90-01544

**LAKE ICE FORMATION AND BREAKUP AS AN INDICATOR OF CLIMATE CHANGE: POTENTIAL FOR MONITORING USING REMOTE SENSING TECHNIQUES.**
Cooperative Inst. for Research in Environmental Science, Boulder, CO.
J. A. Maslanik, and R. G. Barry.
IN: The Influence of Climate Change and Climatic Variability on the Hydrologic Regime and Water Resources, International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication No. 168, 1987. p 153-161, 4 fig, 1 tab, 10 ref. DOE contract DE-AC02-83ER60106.

Descriptors: *Climatology, *Lake ice, *Paleoclimatology, *Remote sensing, *Ice formation, *Ice breakup, Satellite technology.

Freezeup and breakup dates of lakes, which can serve as indicators of climatic change, are analyzed by remote sensing techniques. Visible-wavelength images from the DMSP satellite are used. A comparison is made of the dates of freezeup and breakup of lakes in Finland and Canada as determined by ground observers and by visual imagery interpretation. For breakup, the dates from image interpretation are several da later than breakup dates from ground observations; the differences decrease inland and vary with lake size and shape. Cloud cover in autumn in both regions prevents the use of satellite imagery to assess lake freezeup. The results emphasize the possibilities for satellite data analysis in the study of regional climate variations. (See also W90-01537) (Author's abstract)
W90-01551

**MASS BALANCE OF NORTH CASCADE GLACIERS AND CLIMATIC IMPLICATIONS.**
Maine Univ. at Orono. Inst. for Quaternary Studies.
M. S. Pelto.
IN: The Influence of Climate Change and Climatic Variability on the Hydrologic Regime and Water Resources, International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication No. 168, 1987. p 163-171, 3 fig, 2 tab, 12 ref.

Descriptors: *Rainfall variability, *Glacier balance, *Climatology, *Glaciohydrology, Temperature, Precipitation, Washington State.

A mass balance inventory of North Cascade, Washington glaciers was conducted to determine their response to recent climatic change, and the consequent changes in glacier runoff. The changing reservoir capacity and mean annual mass balance was determined on 47 North Cascade Glaciers. On 10 of these glaciers the annual mass balance was measured for 1984, 1985 and 1986. The annual mass balance is a function of 3 climatic parameters: accumulation season cyclonic activity, ablation season temperature, and summer anticyclonic activity. Since 1977 an increasing frequency of anticyclonic conditions has caused a 1.1 deg C rise in ablation season temperature and a 15% decrease in winter precipitation. The result has been a mean annual balance of -0.30 m to -0.55 m water equivalent, for the 1977-1986 period. The decrease in annual winter balance and glacier accumulation area has also caused a 15% to 24% decrease in glacier reservoir capacity, the amount of meltwater a glacier can store. (See also W90-01537) (Author's abstract)
W90-01552

**GLACIAL AND HYDROLOGICAL REGIME UNDER CLIMATIC INFLUENCE IN THE URUMQI RIVER, NORTHWEST CHINA.**
Academia Sinica, Lanzhou (China). Lanzhou Inst. of Glaciology and Cryopedology.
For primary bibliographic entry see Field 2B.
W90-01569

**PRIMARY STUDY OF THE RELATIONSHIP BETWEEN GLACIAL MASS BALANCE AND CLIMATE IN THE QILIAN MOUNTAIN TAKING 'JULY FIRST' GLACIER AS AN EXAMPLE.**
Academia Sinica, Lanzhou (China). Lanzhou Inst. of Glaciology and Cryopedology.
Z. Xie, and C. Liu.
IN: The Influence of Climate Change and Climatic Variability on the Hydrologic Regime and Water Resources, International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication No. 168, 1987. p 379-388, 3 fig, 2 tab, 6 ref.

Descriptors: *Climatology, *Glaciers, *Glacier mass balance, *China, Temperature, July First Glacier, Thickness, Melting.

The average summer (from June to August) air temperature is 1 C lower and the equilibrium line 88 m lower in the 18 yrs after 1968 than the 11 yrs before 1968 in the Qilian Mountain, China. It was indicated from calculation that an increase (decrease) of 1 C in air temperature would result in a rise (or drop) of 80 m of the equilibrium line. If taking the base station (3700 m.a.s.l.) temperatures above 0 C and below 0 C at the glacial terminus as a temperature index for the beginning and the end of the glacial melting period respectively, the melting period is 14 da shorter in average in the 18 yrs after 1968 than the 11 yrs before 1968 and the

maximum ablation altitude has dropped by 130 m in average on 'July First' Glacier in the middle of the Qilian Mountain. It was found from the mass balance reconstructed according to air temperature and precipitation from 1957 to 1985 on 'July First' Glacier (with an area of 3.0 sq km) that it was characterized by a negative mass balance state in the 11 yrs before 1968 with a cumulative negative mass balance value of 232.9x10000cu m and characterized by a positive mass balance state in the 18 yrs after 1968 with a cumulative positive mass balance value of 773.4x10000cu m. In the recent 30 yrs, net mass balance has increased by 540.5x10000cu m and average glacial thickness increased by 1.8 m. Relatively larger positive mass balance appeared in 1967/68, 1975/76, 1982/83, which showed periodical cycles of 7-8 yrs. The shortening of the ablation period and drop in summer temperature since the middle 1960's and the increase in precipitation since the 1970's have resulted in positive mass balance and a decrease of glacial retreat. (See also W90-01537) (Author's abstract)
W90-01570

**LARGE SCALE EFFECTS OF SEASONAL SNOW COVER.**
Proceedings of an International Symposium held during the XIXth General Assembly of the International Union of Geodesy and Geophysics at Vancouver, British Columbia, Canada, 9-22 August 1987. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. 1987. IAHS Publication No. 166. Edited by B. E. Goodison, R. G. Barry, and J. Dozier. 425p.

Descriptors: *Snow cover-atmospheric relationships, *Snow cover, *Remote sensing, *Climatology, *Symposium, *Model studies, Soil water, Rainfall-runoff relationships.

This symposium has three main themes: role of snow cover in climate dynamics (polar and midlatitude regions); large-scale hydrological aspects of snow cover; and, remote sensing of snow cover. Aspects of particular interest for snow climate interactions include snow cover as a climate indicator and for climate system monitoring, and snow cover parameterization for climate modeling. For hydrological effects, the focus is on interrelationships between snow cover, snow melt, flooding, spring soil moisture and runoff in large basins (>2500 sq km), as well as the effect of spatial variability of inputs and model parameters and the appropriate scale for modeling. In remote sensing, the emphasis is on properties measurable by remote sensing, the mapping of snow cover in polar, midlatitude and mountain regions, the use of remotely sensed data in hydrological/climatological models and the integration of remotely sensed and ground based snow measurements. (See W90-01851 thru W90-01885) (Author's abstract)
W90-01850

**LARGE SCALE EFFECTS OF SEASONAL SNOW COVER.**
Illinois Univ. at Urbana-Champaign. Dept. of Atmospheric Sciences.
J. E. Walsh.
IN: Large Scale Effects of Seasonal Snow Cover. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication No. 166, 1987. p 3-14, 6 fig, 18 ref. NSF Grant No. ATM-8507782.

Descriptors: *Snow cover-atmospheric relationships, *Snow cover, *Model studies, *Cyclones, *Climatology, *Meteorology, *Weather forecasting, Model studies.

The effects of snow cover on the large-scale atmospheric circulation are examined through composite analyses derived from observed synoptic events and through a series of 30-day forecasts from the global circulation model of the National Center for Atmospheric Research. Both approaches focus on the eastern North American region. The composite analyses show that extensive snow cover favors more rapid intensification and northward trajectories of cyclones along the eastern margin of the continent. The 30-day model experiments indicate a qualitatively similar response in which sea level pressure is higher inland and lower along the coast when extensive snow cover is prescribed. The results obtained here are placed into the perspective of other recent studies employing a variety of data-based and modelling strategies. (See also W90-01850) (Author's abstract)
W90-01851

**SNOW COVER AS AN INDICATOR OF CLIMATE CHANGE.**
Lamont-Doherty Geological Observatory, Palisades, NY.
D. A. Robinson.
IN: Large Scale Effects of Seasonal Snow Cover. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication No. 166, 1987. p 15-25, 5 fig, 3 tab, 21 ref. NSF Grant No. ATM 86-18676. USAF Grant No. AFOSR 86-0053.

Descriptors: *Snow cover-atmospheric relationships, *Snow cover, *Remote sensing, *Climatology, *Climatic change, Great Plains, Seasonal variation.

January snow cover in portions of the Midwest and Great Plains of the United States has shown significant variations during this century on year-to-year and long-term time frames. Over the past forty years, snow cover has increased in each region. This trend began in the late 1920's in the Plains, while in the Midwest the recent trend was preceded by several decade-long oscillations. Snow cover data used in the analysis included nearly complete records from twenty ground stations between 1901 and 1978 and weekly satellite-derived charts between 1967 and 1986. There is a reasonable agreement between regional analyses made with each of the independent data sets for the 1967-1978 interval. There appears to be a positive relationship between colder and snowier-than-normal and warmer-than normal and relatively snow-free Januaries. (See also W90-01850) (Author's abstract)
W90-01852

**SNOW COVER--ATMOSPHERIC INTERACTIONS.**
Nebraska Univ., Lincoln. Dept. of Geography.
K. F. Dewey.
IN: Large Scale Effects of Seasonal Snow Cover. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication No. 166, 1987. p 27-42, 8 fig, 3 tab, 16 ref.

Descriptors: *Snow cover-atmospheric relationships, *Snow cover, *Meteorology, *Climatology, *Cyclones, Remote sensing, Atmosphere, Mapping.

Digitized weekly snow cover maps were utilized to investigate snow cover-atmospheric interactions. Several height fields were correlated with snow cover extent for North America on a concurrent as well as a positive and negatively lagged basis. Concurrent relationships, and lowest upper-air level height fields were the most significantly correlated. Examining cyclonic paths, the frequency of cyclones appeared to increase across the Southeastern United States during extensive snow cover years. Winter tornado outbreaks across the Gulf states also appeared to be directly modulated by the extent of North American snow cover. Several United States regions had high spring time correlations between continental snow cover extent and tornado frequency. A comparison of tornado/snow cover anomalies produced the most promising 'snow cover influence' results. (See also W90-01850) (Author's abstract)
W90-01853

**PARAMETERIZATION OF SNOW ALBEDO FOR CLIMATE MODELS.**
Cooperative Inst. for Research in Environmental Science, Boulder, CO.
S. E. Marshall, and S. G. Warren.
IN: Large Scale Effects of Seasonal Snow Cover. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication No. 166, 1987. p 43-50, 5 fig, 4 ref.

Descriptors: *Snow cover-atmospheric relationships, *Snow cover, *Model studies, *Albedo, *Meteorology, Snowpack, Climatology.

Results of general circulation models (GCMs) are sensitive to the assumed value of snow albedo. Snow albedo is highly variable, and it is not calculated accurately in present-day GCMs. Most GCMs assign a single value to the albedo of an optically-thick snow cover. The albedo values range from 0.55 to 0.85, and generally remain constant with time until the snowpack decays to some critical depth, then decrease as a function of the snow depth until the albedo reaches the albedo of the underlying surface. Other GCMs allow the snow albedo to vary with solar zenith angle, snowpack thickness, age of the snow layer, and latitude. It is desirable to replace the current simple empirical parameterizations of snow albedo with a physically-based parameterization which is accurate yet efficient to compute. (See also W90-01850) (Author's abstract)
W90-01854

**SEASONAL VARIATION OF EURASIAN SNOW COVER AND ITS IMPACT ON THE INDIAN SUMMER MONSOON.**
Nairobi Univ. (Kenya). Dept. of Meteorology.
O. S. R. U. Bhanu Kumar.
IN: Large Scale Effects of Seasonal Snow Cover. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication No. 166, 1987. p 51-60, 4 fig, 3 tab, 19 ref.

Descriptors: *Climatology, *Meteorology, *Snow cover-atmospheric relationships, *Snow cover, *Model studies, *Satellite technology, *Monsoons, *India, Remote sensing, Seasonal variation.

Seasonal variations of snow cover extent over Eurasia were derived from satellite data produced by the National Environmental Satellite Services for the period 1966-1985. Indian summer monsoon data were from the India Meteorological Department. Winter (December-March) and spring (March-May) snow cover areas exhibited increasing trends with time, but they were not very significant. The influence of winter and spring snow cover extents on the dates of onset of monsoon over Kerala and total monsoon rainfall over India was noteworthy. The year-to-year variations of dates of onset of the phenomenon was positively correlated more with the winter snow cover area ($r=0.51$) than with the other variables. The winter snow cover was also negatively correlated with the Indian monsoon rainfall. These relationships with Eurasian winter snow cover extent are important input elements for developing Long Range Forecasting of monsoon activity. (See also W90-01850) (Author's abstract)
W90-01855

**STATISTICAL STUDIES OF THE ATMOSPHERIC CIRCULATION OF THE NORTHERN HEMISPHERE, HYDROCLIMATIC REGIMES IN CHINA AND ANTARCTIC ICE-SNOW COVER.**
Academia Sinica, Beijing (China). Inst. of Geography.
G. Peng, and M. Domros.
IN: Large Scale Effects of Seasonal Snow Cover. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication No. 166, 1987. p 61-72, 3 fig, 3 tab, 12 ref.

Descriptors: *Snow cover-atmospheric relationships, *Snow cover, *Model studies, *Air circulation, *Weather forecasting, *Climatology, *China, *Antarctic, Meteorology.

On the basis of 10-yr monthly and long-term annual data, the connections of different indices of

the atmospheric circulation of the Northern Hemisphere and some hydroclimatic regimes in China with the Antarctic ice-snow indices have been discussed, using correlation, regression, step-wise regression, power-spectral and cross-spectral analyses. The results show that there are close correlations between some meteorological conditions of the Northern Hemisphere and the Antarctic ice-snow cover, in particular, between the Northwestern Pacific subtropic high or the annual run-off of Yellow River at Sanmenxia station and the ice-snow indices. The strongest correlations often appear with some time lags of the meteorological and hydrological conditions behind the ice-snow variations. These connections are helpful for hydroclimatic forecasting. (See also W90-01850) (Author's abstract)
W90-01856

**INTERACTIONS BETWEEN THE SNOW COVER AND THE ATMOSPHERIC CIRCULATIONS IN THE NORTHERN HEMISPHERE.**
Tsukuba Univ. (Japan). Inst. of Geoscience.
Y. Morinaga, and T. Yasunari.
IN: Large Scale Effects of Seasonal Snow Cover. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication No. 166, 1987. p 73-78, 2 fig, 10 ref.

Descriptors: *Climatology, *Meteorology, *Snow cover-atmospheric relationships, *Snow cover, *Model studies, *Air circulation, *Satellite technology, Hemispheric interactions.

Hemispheric interactions between large-scale snow cover over the two continents (Eurasia and North America) and the atmospheric circulation in the Northern Hemisphere have been investigated for the period from November 1966 to December 1982. Lag correlations were computed between snow cover extent of central Asia and eastern North America and the 500 mb geopotential height field in the Northern Hemisphere, using NOAA/NESDIS Satellite Snow Cover data and 500 mb geopotential height data. The snow cover-atmospheric interactions are more hemispheric in central Asia than in eastern North America with the lags of more than a month. In eastern North America, concurrent correlation is prominent. Strong lag correlations are detected between February snow cover in central Asia and the geopotential height anomalies in December, which was specified previously as the Eurasian pattern. February snow cover, in turn, has a considerable lingering effect on the atmosphere in April. (See also W90-01850) (Author's abstract)
W90-01857

**TEMPORAL AND SPATIAL VARIATIONS OF THE SNOW COVER IN THE SWISS ALPS.**
Eidgenoessische Technische Hochschule, Zurich (Switzerland).
H. Lang, and M. Rohrer.
IN: Large Scale Effects of Seasonal Snow Cover. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication No. 166, 1987. p 79-92, 5 fig, 2 tab, 9 ref.

Descriptors: *Snow cover-atmospheric relationships, *Snow cover, *Alpine regions, *Seasonal variation, Spatial distribution, Temporal distribution, Switzerland, Model studies.

The main characteristics of temporal and spatial snow depth and water equivalent distributions in the Swiss Alps are analyzed over the period from 1951 to 1980. Frequency distributions of the water equivalent on 1st April show significant differences for the various regions of the Alps, reflecting the corresponding climatic differences. This is also true for the temporal variations of the snow cover during single winter accumulation periods and particularly for single precipitation events. According to the synoptic weather processes, the large-scale development of the snow cover in the Alps shows large yr-to-yr variations. An attempt was made to analyze weather types together with the corresponding particular snow precipitation distributions. The results obtained encourage making use of the available synoptic meteorological information in large-scale snow cover modelling or even in the prediction of the impact climatic variations may have on the occurrence and distribution of the alpine snow cover. (See also W90-01850) (Author's abstract)
W90-01858

**SEASONAL SNOW RESOURCES AND THEIR FLUCTUATIONS IN CHINA.**
Academia Sinica, Lanzhou (China). Lanzhou Inst. of Glaciology and Cryopedology.
P. Li.
IN: Large Scale Effects of Seasonal Snow Cover. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication No. 166, 1987. p 93-104, 8 fig, 11 ref. 23Descriptors: *Snow cover-atmospheric relationships, *Snow cover, *Snow depth, *Snowmelt, *Runoff, *China, Seasonal variation, Model studies, Temporal distribution, El Nino.

Based on data on daily depth and density of snow cover and snowfall recorded at more than 2,300 weather stations in China from 1951 to 1980, the snow resources have been evaluated and their secular variations have been clarified. The mean annual snowfall recharge is 345.18 cu Gm, whereas the mean winter snow water storage and spring snowmelt runoff were found to be 53.56 cu Gm and 23.57 cu Gm, respectively. Snow resources display the following characteristics: poor but also significant amount; uneven regional distribution; prominent seasonal and inter-annual variations; changeable storage throughout the winter; and, monthly distribution being contrary to the coldest months on the Tibet plateau. The time series of snow resources revealed that they are consistent with the sea level changes, temperature oscillations, as well as areal variation of farmlands which suffered from droughts in China. They are also in good agreement with the snow cover extent behavior of the Northern Hemisphere. The heavier snow appears to be associated with the El Nino-Southern Oscillation. (See also W90-01850) (Author's abstract)
W90-01859

**IMPORTANCE AND EFFECTS OF SEASONAL SNOW COVER.**
Eidgenoessisches Inst. fuer Schnee- und Lawinenforschung, Davos (Switzerland).
J. Martinec.
IN: Large Scale Effects of Seasonal Snow Cover. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication No. 166, 1987. p 107-120, 10 fig, 2 tab, 28 ref.

Descriptors: *Data acquisition, *Water resources data, *Snow cover-atmospheric relationships, *Snow cover, *Model studies, *Satellite technology, *Remote sensing, Climatology, Meteorology.

In spite of the impressive volume of ice on the earth, the seasonal snow cover is more important in particular in industrialized countries of the Northern Hemisphere. It constitutes a valuable natural resource, but has also adverse effects like avalanches and loads on structures. Measurements of the occurrence, depth and water equivalent of snow are regularly carried out but need further improvement, especially for operational river flow forecasts. Systematic gathering of snow data in established centers facilitates their use and the evaluation of return periods for extreme events. Efficient large scale monitoring of the seasonal snow cover becomes possible by an increasing application of remote sensing from satellites. (See also W90-01850) (Author's abstract)
W90-01860

**LARGE SCALE EFFECTS OF SEASONAL SNOW COVER AND TEMPERATURE INCREASE ON RUNOFF.**
Agricultural Research Service, Beltsville, MD. Hydrology Lab.
A. Rango, and J. Martinec.
IN: Large Scale Effects of Seasonal Snow Cover. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication No. 166, 1987. p 121-127, 6 fig, 7 ref.

Descriptors: *Snow cover-runoff relationships, *Water yield, *Snow cover-atmospheric relationships, *Snow cover, *Model studies, *Snowmelt, *Runoff, Seasonal variation.

The seasonal snow cover influences runoff in large mountain basins and cold regions. Typical features of snowmelt runoff are regular daily fluctuations and the absence of sharp sudden peaks characteristic for rainfall floods. The effect of a possible warmer future climate on runoff is studied by simulating snowmelt runoff in a large alpine basin for hypothetically increased temperatures. The runoff becomes higher in the first part of the snowmelt season and decreases in the subsequent part. (See also W90-01850) (Author's abstract)
W90-01861

**ESTIMATES OF POSSIBLE VARIATIONS OF SNOWMELT-RUNOFF CHARACTERISTICS ON CLIMATIC CHANGES.**
Akademiya Nauk SSSR, Moscow. Inst. Vodnykh Problem.
L. S. Kuchment, Y. G. Motovilov, E. L. Muzylev, and N. A. Nazarov.
IN: Large Scale Effects of Seasonal Snow Cover. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication No. 166, 1987. p 129-138, 1 fig, 3 tab, 3 ref.

Descriptors: *Water yield, *Snow cover-runoff relationships, *Snow cover-atmospheric relationships, *Snow cover, *Model studies, *Snowmelt, *Runoff, Seasonal variation, USSR, Model studies.

Models of snowmelt runoff formation processes have been constructed and calibrated, using available observation data, for three drainage basins located in different physiographic and climatic zones. Estimates of the sensitivity of hydrological systems to climatic changes have been obtained and possible variations of the runoff hydrograph under the effect of expected man-induced climatic changes have been estimated. It follows from the estimates presented that a 5-10% increase in runoff may be expected from a 10-15% increase in winter precipitation and a 1-2 deg C increase in the air temperature for the northern part of the forest zone of the USSR. In more southern regions, where antecedent moistening and soil freezing depth are important, these precipitation and temperature variations may lead to a decrease in spring flood volume. Relative snowmelt-runoff variations in mountain basins are similar to relative precipitation variations; a temperature increase of 2-3 deg C may result in a runoff decrease of 15-20%. (See also W90-01850) (Author's abstract)
W90-01862

**METHOD FOR INDEXING THE VARIABILITY OF ALPINE SEASONAL SNOW OVER LARGE AREAS.**
Otago Univ., Dunedin (New Zealand). Dept. of Geography.
B. B. Fitzharris.
IN: Large Scale Effects of Seasonal Snow Cover. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication No. 166, 1987. p 139-150, 6 fig, 2 tab, 17 ref.

Descriptors: *Snow cover-atmospheric relationships, *Snow cover, *Model studies, *Snow surveys, *Data acquisition, New Zealand.

Assessing the size of the seasonal snow cover sometimes requires not so much estimates of the absolute quantity of water stored as snow, but a measure of its variability from a long term average. Over large areas of the alpine world there are no snow courses to make these assessments, so alternative methods must be found. A technique for estimating the relative size of seasonal snow cover using climate station data from lowland sites is

described. A snow storage index is derived using weekly departures from average of precipitation and temperatures recorded at 21 climate stations adjacent to the mountain areas of the South Island of New Zealand. Data for each climate station is weighted according to how well it represents economically important river basins that flow into large hydroelectric storage lakes. Examples are given of the behavior of the index over eight winters. (See also W90-01850) (Author's abstract)
W90-01863

**MODELLING LARGE SCALE EFFECTS OF SNOW COVER.**
British Columbia Univ., Vancouver.
A. Pipes, and M. C. Quick.
IN: Large Scale Effects of Seasonal Snow Cover. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication No. 166, 1987. p 151-160, 6 fig, 7 ref.

Descriptors: *Energy, *Snow cover-runoff relationships, *Water yield, *Snow cover-atmospheric relationships, *Snow cover, *Model studies, *Snowmelt, *Flood forecasting, Energy.

Large scale effects of snow cover are subdivided into two major issues: the weather-modifying effect of energy balance over extensive snow cover, and snowmelt flood production capability. Modification of tree cover is argued to be a sensitive factor in energy balance and flood production. Equations are presented which define the energy available to the atmosphere and for snowmelt. If cloud cover, albedo and wind data are not available, they are represented by using temperature data. This temperature controlled energy balance method is shown to yield good estimates of point snowmelt for forested and open areas. Comparison is made with the degree-day approach. The snowmelt studies are extended to calculation of streamflow runoff from small mountain watersheds and from large mountain watersheds in British Columbia and the Himalayas, and these results confirm the usefulness of this temperature controlled energy budget approach. (See also W90-01850) (Author's abstract)
W90-01864

**SNOWMELT-RUNOFF SIMULATION MODEL OF A CENTRAL CHILE ANDEAN BASIN WITH RELEVANT OROGRAPHIC EFFECTS.**
Direccion General de Aguas, Santiago (Chile).
H. Pena, and B. Nazarala.
IN: Large Scale Effects of Seasonal Snow Cover. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication No. 166, 1987. p 161-172, 7 fig, 4 tab, 5 ref.

Descriptors: *Snow cover-runoff relationships, *Water yield, *Snow cover-atmospheric relationships, *Snow cover, *Model studies, *Snowmelt, *Runoff, *Chile, Naipo River Basin.

A snowmelt-runoff simulation model of the upper Naipo River basin, located in the Andean highlands of Central Chile, is presented. Empirical relations developed for the area are used to compute the snow and ice melt. The influence of the spatial structure of the model and the redistribution of snow falling on high slope surfaces are discussed. The role of semi-perennial snow covered areas and the runoff from the glaciers are emphasized. (See also W90-01850) (Author's abstract)
W90-01865

**UTILITY OF COMPUTER-PROCESSED NOAA IMAGERY FOR SNOW COVER MAPPING AND STREAMFLOW SIMULATION IN ALBERTA.**
Alberta Environment, Edmonton.
S. Ferner, and I. Sutherland.
IN: Large Scale Effects of Seasonal Snow Cover. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication No. 166, 1987. p 173-185, 6 fig, 1 tab, 16 ref.

Descriptors: *Snow cover-runoff relationships, *Water yield, *Snow cover-atmospheric relationships, *Snow cover, *Model studies, *Snowmelt, *Satellite technology, *Remote sensing, *Canada, Simulation analysis, Alberta.

Computer processed NOAA satellite imagery for a large (2210 sq km) mountainous basin of Alberta was found to be useful for snowmelt modelling using SSARR (Streamflow Synthesis and Reservoir Regulation) in 1985 and 1986. The % SCA (snow covered area) versus & SWE (snow water equivalent) relationship used in the snowmelt routine of the model is defined by forcing the model to use NOAA SCA estimates. The % SCA versus % SWE (snow water equivalent) relationship used in the snowmelt routine of the model is defined by forcing the model to use NOAA SCA estimates. The % SCA versus % SWE curve is markedly different in the 2 yrs modelled, and results suggest that a family of curves with initial SWE as the third parameter will improve simulation results. SCA statistics were generated for a series of cloud-free dates in each yr by a one-dimensional thresholding of channel 2 (near IR) data. A technique for correcting the illumination of images with a lower solar angle is presented. (See also W90-01850) (Author's abstract)
W90-01866

**SNOW COVER AREA (SCA) IS THE MAIN FACTOR IN FORECASTING SNOWMELT RUNOFF FROM MAJOR RIVER BASINS.**
National Remote Sensing Agency, Hyderabad (India). Hydrology Div.
A. S. Ramamoorthi.
IN: Large Scale Effects of Seasonal Snow Cover. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication No. 166, 1987. p 187-198, 3 fig, 5 tab, 4 ref.

Descriptors: *Snow cover-runoff relationships, *Remote sensing, *Water yield, *Snow cover-atmospheric relationships, *Snow cover, *Model studies, *Snowmelt, *Runoff forecasting, India.

In developing countries like India, the forecasting of snowmelt runoff, both seasonal and short-term, is vital for optimum development of the summer flows for power generation, irrigation and drinking water supply. For accurate simulation and forecasting, one would like to have data regarding snow cover extent, precipitation, temperature, depth of snowpack water equivalent, etc. But such data are scarce and not always available, especially in respect to large mountainous basins in the Himalayas. Most of the snowmelt runoff models that have been developed in Europe and USA relate to small catchments and they are simulation models. Of these, the well known Martinec-Rango Model (SRM), which uses snow cover area obtained from satellite data, daily precipitation and temperature etc., has been applied in basins with catchment areas up to 4000 sq km and efforts are being made to use this model for larger basins. With the advent of satellite remote sensing technology in India, especially the availability of NOAA satellite data, it became possible to attempt snowmelt runoff studies. From a study of the Sutlej river basin above Bhakra (catchment area 43,230 sq km) a regression model was developed using % of snow covered area and seasonal snowmelt runoff to forecast the runoff during the 4 yrs 1980-1983. The forecast quantities varied from the measured discharges at Bhakra by $< 10\%$. As temperature is also an important parameter, efforts were made to examine the effect of temperature in addition to snow covered area in the Sutlej basin. It has been found that the effect of temperature on the variation of seasonal snowmelt runoff from yr to yr will not be significant since the changes in the temperatures during the different yrs in the snowmelt runoff period is not significant. Hence, snow cover area is the main factor in forecasting snowmelt runoff of major mountainous river basins like that of Sutlej. (See also W90-01850) (Author's abstract)
W90-01867

**MODELLING OF SNOWMELT DISTRIBUTION FOR THE ESTIMATION OF BASIN-WIDE SNOWMELT USING SNOW COVERED AREA.**
Tokyo Univ. (Japan). Dept. of Civil Engineering.
T. Koike, Y. Takahasi, and S. Yosino.
IN: Large Scale Effects of Seasonal Snow Cover. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication No. 166, 1987. p 199-212, 15 fig, 4 tab, 5 ref.

Descriptors: *Water yield, *Snow cover-runoff relationships, *Snow cover, *Model studies, *Snowmelt, *Remote sensing, *Snow cover-atmospheric relationships, Satellite technology, Japan.

Information on snow covered area derived from remote sensing technology is available for estimation of basin-wide snowmelt. It is necessary to clearly identify the distribution of snowmelt in order to estimate basin-wide snowmelt precisely using snow covered data obtained through LANDSAT MSS and NOAA AVHRR. A model for estimation of snowmelt distribution is presented which is based on the meteorological observations and snow surveying in Syozawa basin, Japan. This model includes net radiation, deg-hr approach and a combination of condensation and evaporation applicable for rainy days. At first the observational base, which is the flat and open area, is modelled using insolation, air temperature and precipitation. The result of the application of the model to the base is in good agreement with observed data. Next the model is applied to slopes and a forested area. In the case of the slopes, air temperature is decreased with elevation and insolation is corrected by the insolation receiving rate on the slopes. In the case of the forested area, insolation is corrected by forest canopy cover rate. In both cases the model results are in good agreement with the observed data. Therefore, the model for snowmelt at the base can be applied to any site covered with snow in the basin by correcting insolation and air temperature according to topographical characteristics. (See also W90-01850) (Author's abstract)
W90-01868

**OPERATIONAL AIRBORNE MEASUREMENTS OF SNOW WATER EQUIVALENT AND SOIL MOISTURE USING TERRESTRIAL GAMMA RADIATION IN THE UNITED STATES.**
National Weather Service, Minneapolis, MN. Office of Hydrology.
T. R. Carroll.
IN: Large Scale Effects of Seasonal Snow Cover. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication No. 166, 1987. p 213-223, 2 fig, 1 tab, 9 ref.

Descriptors: *Snow cover-runoff relationships, *Snow cover, *Model studies, *Remote sensing, *Flood forecasting, *Snow surveys, *Gamma radiation, Snow cover-atmospheric relationships, Soil water, North America, Instrumentation.

The National Weather Service (NWS) maintains an Airborne Gamma Radiation Snow Survey Program to make operational, real-time snow water equivalent and soil moisture measurements over a network of 1250 flight lines covering portions of 23 states and 5 Canadian provinces. The Airborne Program provides airborne snow and soil moisture measurements to hydrologists in the National Weather Service and other Federal and state agencies. The real-time data are used operationally by the NWS hydrologists when issuing river and flood forecasts, water supply forecasts, and spring flood outlooks for large areas of the country. Airborne snow water equivalent measurements are typically made over agricultural areas with a root mean sq error of 8 mm and over forested areas with a root mean sq error of 23mm water equivalent. (See also W90-01850) (Author's abstract)
W90-01869

**DETERMINATION OF WATER EQUIVALENT OF SNOW AND THE FORECAST OF SNOWMELT RUNOFF BY MEANS OF ISOTOPES IN TURKEY.**

State Hydraulic Works, Ankara (Turkey). Technical Research and Quality Control Dept.
I. Ertan.
IN: Large Scale Effects of Seasonal Snow Cover. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication No. 166, 1987. p 225-239, 13 fig, 10 ref.

Descriptors: *Runoff forecasting, *Water yield, *Snow cover-runoff relationships, *Snow cover, *Model studies, *Gamma radiation, *Snowmelt, *Runoff, *Snow cover-atmospheric relationships, Flow measurement, Turkey, Instrumentation.

For the first time in Turkey, water equivalent of snow pack and runoff were determined by the absorption of gamma radiation passing through a snowpack and the environmental isotope, respectively. Regression equations for the snow depth and water equivalent of snow were determined by using both the nuclear and the classical techniques. A good relation between the flow hydrograph and the (18)O SMOW (Standard Mean Ocean Water) values was observed. Thus, the long term forecasting model of seasonal spring flood volume is presented by the nuclear technique. By using the flow hydrograph and the environmental isotope content of water samples, the sub-surface flow hydrograph and the surface flow hydrograph were determined using the nuclear technique. By using these research methods in snow hydrology, exact values were obtained. It was discovered that the nuclear techniques can be applied either together with the classical techniques or without them. (See also W90-01850) (Author's abstract)
W90-01870

**MODELLING THE EFFECTS OF AGROTECHNICAL MEASURES ON SPRING RUNOFF AND WATER EROSION.**
Akademiya Nauk SSSR, Moscow. Inst. Vodnykh Problem.
Y. G. Motovilov.
IN: Large Scale Effects of Seasonal Snow Cover. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication No. 166, 1987. p 241-251, 3 fig, 3 tab, 9 ref.

Descriptors: *Snow cover-runoff relationships, *Snow cover, *Model studies, *Infiltration, *Snowmelt, *Runoff, *Soil erosion, *Snow cover-atmospheric relationships, USSR.

The paper presents the structure and basic equations of a physically based model describing the formation of meltwater runoff in the river basin. A system of equations of heat and moisture transfer is used to determine the hydrophysical and thermophysical characteristics of snow and soil as well as snow cover depth. Tests of the model for the Trud and Sosna River basins provided a good agreement between calculated and measured values. Regarding its application to the problems of estimating the effects of agrotechnical measures on the runoff and water erosion, the model was used to estimate the combined effects of fall plowing and planting perennial herbs on soil particle washing-off. (See also W90-01850) (Rubinstein-PTT)
W90-01871

**INFLUENCE OF THE VARIABILITY OF SNOW COVER THICKNESS ON THE INTENSITY OF WATER YIELD AND DURATION OF SPRING FLOOD ON A SMALL RIVER.**
Gosudarstvennyi Gidrologicheskii Inst., Leningrad (USSR).
B. M. Dobroumov, and A. B. Shukhobodsky.
IN: Large Scale Effects of Seasonal Snow Cover. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication No. 166, 1987. p 253-283, 6 fig, 16 ref.

Descriptors: *Water yield, *Snow cover-runoff relationships, *Snow cover, *Floods, *Snowmelt, *Runoff, *Snow cover, *Snow cover-atmospheric relationships, Steppes, Forests, Model studies, Statistical analysis.

The main factor influencing prediction of maximum spring runoff from snowmelt is the uneven thickness of snow cover over the drainage basin area. Investigations carried out over several small plain drainage basins in a forest-steppe zone with a highly dissected surface showed that the use of standard values of parameters of the distribution of water equivalent of snow over a basin may result in large errors in determining water yield duration and intensity, and hence the maximum runoff for the year or for a long-term period. For practical applications use, it is suggested to use statistical relations between the coefficients of variation of the water equivalent of the snow cover and standard meteorological elements such as the average snow depth over the basin and mean water equivalent of the snow cover. Correlations between snow cover distribution parameters with respect to different landscape types are discussed. (See also W90-01850) (Author's abstract)
W90-01872

**SIMPLE SNOWPACK STRUCTURE MODEL AND ITS APPLICATION TO MOUNTAIN SNOWPACK PROBLEMS.**
California State Univ.-San Bernadino. Dept. of Geography.
L. Dexter.
IN: Large Scale Effects of Seasonal Snow Cover. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication No. 166, 1987. p 265-275, 9 fig, 13 ref.

Descriptors: *Snow cover-runoff relationships, *Snow cover, *Model studies, *Snowpack, *Colorado, *Snow cover-atmospheric relationships, Simulation analysis.

Simulation models which address the complete structure of a seasonal snow cover are not common and existing models are large. Design of a simple microcomputer based snowpack model was initiated as part of a study investigating terrain effects on the seasonal snow cover in Colorado. Calibration runs of the model reasonably duplicated the observed stratigraphy at a level study plot. Subsequent runs of the model indicate it may be useful for extrapolating estimates of snowpack conditions over a localized range of elevations and aspects. (See also W90-01850) (Author's abstract)
W90-01873

**REMOTE SENSING OF SNOW.**
Innsbruck Univ. (Austria). Inst. fuer Meteorologie und Geophysik.
H. Rott.
IN: Large Scale Effects of Seasonal Snow Cover. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication No. 166, 1987. p 279-290, 3 fig, 1 tab, 40 ref.

Descriptors: *Snow cover-runoff relationships, *Snow cover, *Model studies, *Snowmelt, *Remote sensing, *Satellite technology, *Snow cover-atmospheric relationships, Mapping, Flood forecasting, Monitoring.

Remote sensing methods enable efficient monitoring of the snow cover from the regional to the global scale. Reflection and emission signatures of snow are described in the microwave and optical parts of the spectrum in dependence of various parameters. Satellite images in the visible and near infrared are employed for mapping the snow areal extent. These data area a valuable base for climate studies and are used operationally for snowmelt runoff forecasting. Investigations with spaceborne microwave radiometer data demonstrate the capabilities for all-weather mapping of snow areal extent and water equivalent and for detecting the onset of snowmelt. The main drawback of passive microwave sensors, the limited spatial resolution, can be overcome with active sensors. Synthetic aperture radars can detect wet snow cover and provide high spatial resolution. A significant number of microwave sensors will be launched during the next decade, but increased research efforts are needed to utilize this potential. (See also W90-01850) (Author's abstract)
W90-01874

**DISCUSSION OF THE ACCURACY OF NOAA SATELLITE-DERIVED GLOBAL SEASONAL SNOW COVER MEASUREMENTS.**
Satellite Hydrology, Inc., Vienna, VA.
D. R. Wiesnet, C. F. Ropelewski, G. J. Kukla, and D. A. Robinson.
IN: Large Scale Effects of Seasonal Snow Cover. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication No. 166, 1987. p 291-304, 7 fig, 2 tab, 11 ref. NSF Grant No. ATM 85-05558.

Descriptors: *Snow cover-runoff relationships, *Snow cover, *Model studies, *Satellite technology, *Remote sensing, *Snow cover-atmospheric relationships, Mapping, Meteorological data collection.

The first weekly charting of snow cover in the Northern Hemisphere using meteorological satellite images was begun by the U.S. National Oceanic and Atmospheric Administration (NOAA) in November 1966. While this long-term data base is a significant improvement over ground charts produced solely from ground station data, several real and potential sources of error affect it. Because climatologists who study the effect of large-scale snow cover on the global heat budget utilize these data, evaluation of their accuracy is in order. This paper reviews the results of investigations which have attempted to quantify the noise level in the data and concludes that, except for the fall season, the data are accurate enough for climate-related studies on continental or hemispheric scales. However, care should be exercised and additional verification with station data is recommended before using the product in local or regional studies of snow cover variation. Recommendations are also made for integrating satellite and ground station data and for further development of sensors and remote-sensing techniques from which estimates of snow depth and snow water equivalent can be developed. (See also W90-01850) (Author's abstract)
W90-01875

**REMOTE SENSING OF SNOW CHARACTERISTICS IN THE SOUTHERN SIERRA NEVADA.**
California Univ., Santa Barbara. Center for Remote Sensing and Environmental Optics.
J. Dozier.
IN: Large Scale Effects of Seasonal Snow Cover. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication No. 166, 1987. p 305-314, 5 fig, 2 tab, 21 ref.

Descriptors: *Snow cover-runoff relationships, *Snow cover, *Model studies, *Remote sensing, *Satellite technology, *Snow cover-atmospheric relationships, Albedo, Sierra Nevada.

Estimation of snow characteristics from satellite remote sensing data requires that snow be distinguished from other surface cover and from clouds, compensate for the effects of the atmosphere and rugged terrain, and interpolate snow albedo over the entire solar spectrum from measurements at a few wavelengths. It is also necessary to account for topographic effects without requiring that satellite data be precisely registered to digital elevation data, because the poor quality of most digital elevation data introduces considerable noise into calculations of slope and azimuth. From simulation of a range of snow types and various atmospheric profiles, over possible illumination conditions, typical spectral signatures can be developed above the atmosphere over mountainous terrain, which allow distinction of several classes of snow from other surface covers. (See also W90-01850) (Author's abstract)
W90-01876

**ANALYSIS OF INTERANNUAL VARIATIONS OF SNOW MELT ON ARCTIC SEA ICE**

**MAPPED FROM METEOROLOGICAL SATELLITE IMAGERY.**
Lamont-Doherty Geological Observatory, Palisades, NY.
D. A. Robinson, G. Scharfen, R. G. Barry, and G. Kukla.
IN: Large Scale Effects of Seasonal Snow Cover. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication No. 166, 1987. p 315-327, 6 fig, 2 tab, 27 ref. NSF Grant No. ATM 83-18676, USAF Grant No. AFOSR86-0053, USN Grant No. N00014-86-K-0695.

Descriptors: *Snow cover-runoff relationships, *Snow cover, *Model studies, *Snowmelt, *Satellite technology, *Remote sensing, *Arctic, *Snow cover-atmospheric relationships, Seasonal variation.

The seasonal progression of snowmelt on the Arctic ice pack was mapped from shortwave satellite imagery for 1977, 1979, 1984 and 1985. The 4 yrs showed substantial differences in the timing of the melt interval. The progression of melt in May and June of the earliest melt yr (1977) was about 3 wks ahead of the latest yr (1979). As a result, basin-wide surface albedo varied by upwards of 0.08 in June, ranging from 0.58 in 1977 to 0.66 in 1979. May and July showed interannual variations in albedo of up to 0.05. The extent of snowmelt varied from yr to yr in the central Arctic. The region was essentially snow-free by mid-July in 1977 and 1979, but retained some snow throughout the summer in 1984 and for all but 2 wks in 1985. Although limited in extent, the data base suggests relationships between snowmelt and Arctic surface air temperatures in spring, spring cloudiness, and the extent of late summer ice. (See also W90-01850) (Author's abstract)
W90-01877

**SNOW MELT ON SEA ICE SURFACES AS DETERMINED FROM PASSIVE MICROWAVE SATELLITE DATA.**
Scripps Institution of Oceanography, La Jolla, CA.
M. R. Anderson.
IN: Large Scale Effects of Seasonal Snow Cover. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication No. 166, 1987. p 329-341, 6 fig, 13 ref. NASA Grant No. NAGW-1028).

Descriptors: *Snow cover-runoff relationships, *Snow cover, *Model studies, *Remote sensing, *Arctic, *Sea ice, *Satellite technology, *Snowmelt, *Snow cover-atmospheric relationships, Diurnal distribution, Microwaves, Seasonal variation.

SMMR (Scanning Multichannel Microwave Radiometer) data for the yr 1979, 1980 and 1984 have been analyzed to determine the variability in the onset of melt for the Arctic seasonal sea ice zone. The results show melt commencing in either the Kara/Barents Seas or Chukchi Sea and progressing zonally towards the central Asian coast (Laptev Sea). Individual regions had interannual variations in melt onset in the 10-20 da range. To determine whether daily changes occur in the sea ice surface melt, the SMMR 18 and 37 GHz brightness temperature data are analyzed at day/night/twilight periods. Brightness temperatures illustrate diurnal variations in most regions during melt. In the East Siberian Sea, however, daily variations are observed in 1979, throughout the analysis period, well before any melt would usually have commenced. Understanding microwave responses to changing surface conditions during melt will perhaps give additional information about energy budgets during the winter to summer transition of sea ice. (See also W90-01850) (Author's abstract)
W90-01878

**ESTIMATING SNOWPACK PARAMETERS IN THE COLORADO RIVER BASIN.**
National Aeronautics and Space Administration, Greenbelt, MD. Goddard Space Flight Center.
A. T. C. Chang, J. L. Foster, P. Gloersen, W. J. Campbell, and E. G. Josberger.
IN: Large Scale Effects of Seasonal Snow Cover. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication No. 166, 1987. p 343-352, 3 fig, 1 tab, 11 ref.

Descriptors: *Snow cover-runoff relationships, *Snow cover, *Model studies, *Snowmelt, *Runoff forecasting, *Flood forecasting, *Remote sensing, *Colorado River Basin, *Satellite technology, *Snow cover-atmospheric relationships, Runoff, Microwaves.

Melting snow provides over 70% of the water supply for the western United States. Flooding in the Colorado River basin during the spring and early summer of 1983 led to recognition of the need for better estimates of snowmelt runoff from the high elevation watersheds which contribute most of the runoff for the Colorado River. Improved knowledge of the snow water storage over the entire basin should improve forecasts of spring runoff and allow better management of the water resources. Passive microwave remote sensors have the capability to penetrate the snowpack and respond to variations in snowpack properties, thereby providing information about depth and water equivalent of the snowpack. Observations from the Nimbus-7 Scanning Multi-channel Microwave Radiometer (SMMR) have been used successfully in the past for snow property determination in areas with uniform snow cover such as the Canadian High Plains. The Colorado River basin, which includes rugged terrain and heavy vegetation cover, presents a greater challenge in developing snowpack parameter retrieval techniques. SMMR data for five winter seasons from 1978 to 1983 were studied in order to see if a relationship could be established between microwave brightness temperatures and snow depth measurements made in different elevation zones and physiographic areas of the Colorado River basin. Three yrs of data are being used to develop a snow parameter retrieval algorithm which will then be tested by using the remaining 2 yrs of data. Preliminary results indicate that even in heterogeneous mountainous regions it may be possible to use remotely sensed microwave data to better estimate the water equivalent of high elevation snowpacks. (See also W90-01850) (Author's abstract)
W90-01879

**SNOW COVER PARAMETER RETRIEVAL FROM VARIOUS DATA SOURCES IN THE FEDERAL REPUBLIC OF GERMANY.**
Cooperative Inst. for Research in Environmental Science, Boulder, CO.
A. J. Schweiger, R. Armstrong, and R. G. Barry.
IN: Large Scale Effects of Seasonal Snow Cover. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication No. 166, 1987. p 353-364, 12 fig, 13 ref. NSF Grant No. SES 8518586.

Descriptors: *Snow cover-runoff relationships, *Snow cover, *Snow depth, *Mapping, *Databases, *West Germany, *Remote sensing, *Satellite technology, *Snow cover-atmospheric relationships, Microwaves, Model studies.

Snow depth and water equivalent point measurements from 60 synoptic stations in West Germany were gridded and contoured for 2 seasons. These maps are compared to the results of a simple snow extent algorithm based on brightness temperature data from the Scanning Multichannel Microwave Radiometer (SMMR). Visible band Defense Meteorological Satellite Program (DMSP) imagery as well as NOAA/NESDIS snow charts are used for comparison. The results indicate that snow extent mapping using microwave satellite data is possible. Specific problems arising from the incompatibility of correlative data are effects of terrain, vegetation, and other surface factors, especially at coastlines. There is a need to develop ground measurement database that will allow pixel to pixel comparison with SMMR brightness temperatures. (See also W90-01850) (Author's abstract)
W90-01880

**GLOBAL SNOW COVER AND THE EARTH'S ROTATION.**
National Aeronautics and Space Administration, Greenbelt, MD. Goddard Space Flight Center.
J. L. Foster, D. K. Hall, A. T. C. Chang, B. F. Chao, and W. P. O'Connor.
IN: Large Scale Effects of Seasonal Snow Cover. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication No. 166, 1987. p 365-374, 1 fig, 13 ref.

Descriptors: *Snow cover-runoff relationships, *Snow cover, *Model studies, *Geophysics, *Snow depth, *Satellite technology, *Remote sensing, *Snow cover-atmospheric relationships, Microwaves, Polar motion.

The motion of the Earth's rotation axis with respect to the geographic reference frame, known as the polar motion, consists mainly of an annual wobble and a 14-mo wobble called the 'Chandler wobble'. The annual wobble is a forced motion caused by seasonal changes in the Earth's atmosphere and hydrosphere. Snow has a certain contribution to the annual wobble, but as of yet it is not known how much is contributed. Until recently monthly measurements of global snow volume were too inexact to be able to determine the effect of snow on the Earth's rotation. However, with the launch of the Nimbus satellite in 1978, with its Scanning Multichannel Microwave Radiometer (SMMR) instrument, which is capable of measuring snow cover and estimating snow depth, it is now possible to assess and monitor changes in the distribution of snow mass on the Earth's surface. Preliminary results indicate that an algorithm derived for deducing global snow depth over land from SMMR signals is sufficiently reliable to measure the effects of snow mass on polar motion. It has been found that the snow load excitation has an amplitude that is some 30% of the total annual wobble excitation, thus representing a significant geophysical contribution. (See also W90-01850) (Author's abstract)
W90-01881

**INTEGRATION OF DIGITAL TERRAIN MODELS INTO GROUND BASED SNOW AND RUNOFF MEASUREMENT.**
Saskatchewan Research Council, Saskatoon.
J. Whiting, and J. Kiss.
IN: Large Scale Effects of Seasonal Snow Cover. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication No. 166, 1987. p 375-387, 6 fig, 3 tab, 3 ref.

Descriptors: *Snow cover-runoff relationships, *Snow cover, *Model studies, *Snowmelt, *Runoff forecasting, *Network design, *Remote sensing, *Digital map data, *Canada, *Snow cover-atmospheric relationships, Big Quill Lake, Hydrologic budget.

The study of digital terrain models (DTM) was conducted at Big Quill Lake, Canada. The Wynyard Watershed within the basin was established as a research basin to increase the accuracy of runoff estimation. Aerial photography and satellite data were used to delineate the active part of the watershed from the depression-storage areas. An aerial photographically derived DTM was used to give channel volume, global and local catchment, dispersal area and slope aspect. In Prairie watersheds the runoff behavior is influenced by the frequency components of snow distribution such as land use and topography, and stochastic meteorological events such as spring storms. The DTM model was used to refine the snow course network. The snow course sites were placed such that each site represented an equal volume of channel. A random distribution of snow sites was found to show a bias to the flatter third of the basin. The DTM showed that a significant proportion (38%) of the total runoff from snow was already in the channels before spring runoff began. The use of the DTM model increased the accuracy of spring and annual water budget estimations of Big Quill Lake. (See also W90-01850) (Author's abstract)
W90-01882

**CLASSIFICATION MODEL FOR SPATIAL ESTIMATION OF SNOWPACK VARIABLES FROM SATELLITE DATA.**
Utah State Univ., Logan.
R. W. Gunderson, C. H. Leu, D. S. Bowles, and J. P. Riley.
IN: Large Scale Effects of Seasonal Snow Cover. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication No. 166, 1987. p 389-401, 6 fig, 14 ref.

Descriptors: *Snow cover-runoff relationships, *Snow cover, *Model studies, *Snowpack, *Satellite technology, *Remote sensing, *Snowmelt, *Runoff, *Snow cover-atmospheric relationships, Forecasting.

A new approach to spatial modelling of snowpack variables is made possible by this research by using data obtained from satellite remote sensing platforms. The objective is to develop a methodology which provides accurate spatial estimates of snowpack conditions for use in snowmelt-runoff forecasting. The method combines new developments from the theory of pattern recognition and multivariate data analysis with multispectral measurements available on existing satellite systems, topographical information from digital elevation models, and ground measurement of snowpack properties at a limited number of optimally placed sites. (See also W90-01850) (Author's abstract)
W90-01883

**DISTRIBUTION OF SNOW EXTENT AND DEPTH IN ALASKA AS DETERMINED FROM NIMBUS-7 SMMR MAPS (1982-83).**
National Aeronautics and Space Administration, Greenbelt, MD. Goddard Space Flight Center.
D. K. Hall, A. T. C. Chang, and J. L. Foster.
IN: Large Scale Effects of Seasonal Snow Cover. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication No. 166, 1987. p 403-413, 1 fig, 2 tab, 22 ref.

Descriptors: *Snow cover, *Model studies, *Snow depth, *Remote sensing, *Satellite technology, Alaska, Microwaves.

Scanning Multichannel Microwave Radiometer (SMMR) maps of Alaska for October 1982 through May 1983 are presented showing snow conditions as determined using an algorithm which employs SMMR data to calculate snow depth in 1/2 deg latitude x 1/2 deg longitude grid blocks. An idealized snowpack having a uniform snow grain radius (0.35 mm) and density (300 kg/cu m) was assumed in order to produce a snow depth map for the Northern Hemisphere. As a result, large-scale snow build-up and dissipation patterns are observable. By mid-November, SMMR-derived snow depths are much higher than measured snow depths (approx 24 cm vs 13 cm, respectively) over much of northern Alaska. This is probably due to the depth hoar that forms at the base of those snowpacks causing a reduction in the brightness temperature (T sub B) resulting from the large (up to 1 cm) depth hoar crystals. In spite of heavy forest cover in central Alaska, in mid-February the measured snow depth in Fairbanks (58 cm) corresponds quite well with the SMMR-derived snow depth (36-51 cm). The coefficient of correlation (R) between snow depth and 37 GHz microwave T sub B is -0.70, northern, central and southern Alaska, respectively. Algorithms that are designed for snow conditions that differ from the idealized snowpack need to be developed for areas such as northern and interior Alaska in order to obtain an improved estimate of snow depth. (See also W90-01850) (Author's abstract)
W90-01884

**BIDIRECTIONAL REFLECTANCE OF SNOW AT 500-600 NM.**
Cooperative Inst. for Research in Environmental Science, Boulder, CO.
K. Steffen.
IN: Large Scale Effects of Seasonal Snow Cover. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication No. 166, 1987. p 415-425, 5 fig, 11 ref.

Descriptors: *Snow cover, *Model studies, *Reflectance, *Remote sensing, Albedo, Solar radiation.

The bidirectional reflectance of powder snow, new snow and old snow was measured under various zenith angles at 500-600 nm wavelength. Examples are shown that illustrate the bidirectional properties of the 3 snow types and how these properties vary with solar zenith angle (SZA). Powder snow with grain radii of 0.15 mm has a nearly isotropic uniform reflectance pattern. However, at a reflectance angle of 75 deg, forward scattering $>$ 1.2 (measured in anisotropic reflectance function units) was found at all SZAs in the principal plane of the sun. The anisotropic reflectance is better developed for new snow than for powder snow, and most developed for old snow. For old snow, with grain radii varying from 1-3 mm, maximum anisotropic reflectance function values $>$ 2.0 were found for a reflectance angle of 75 deg for all SZAs. (See also W90-01850) (Author's abstract)
W90-01885

**PHYSICAL BASIS OF ICE SHEET MODELLING.**
Proceedings of an international symposium held during the XIXth General Assembly of the International Union of Geodesy and Geophysics at Vancouver, British Columbia, Canada, 9-22 August 1987. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. 1987. IAHS Publication No. 170. Edited by Edwin D. Waddington and Joseph S. Walder. 384p.

Descriptors: *Glaciology, *Glaciology, *Computer models, *Ice, *Glaciohydrology, *Glaciers, *Symposium, *Model studies, *Ice sheets.

This symposium focuses on the physical descriptions that go into computers, rather than on the numerical algorithms or the results that come out of computers. In earth sciences, space and time scales are orders of magnitude too large to allow experimentation. Therefore, the methodological importance of modeling is stressed because it is the only practical substitute for experimentation. Models allow prediction, and prediction is a prerequisite for action. However, even the most drastic changes in the ice sheets would influence society only after many decades or centuries. Thus, most ice sheet models attempt to explain rather than predict phenomena. Recently ice sheet models have developed from one-dimensional steady state models to more sophisticated time-dependent three-dimensional finite element models that include equations of mass, momentum, and energy balance. Communication between the modelers and field glaciologists is necessary if the next generation of ice sheet models is to be tuned and tested adequately. (See W90-01887 thru W90-01918) (Rubinstein-PTT)
W90-01886

**ICE SHEET MODELS: AN OVERVIEW.**
Colorado Univ., Boulder. Inst. of Arctic and Alpine Research.
M. F. Meier.
IN: The Physical Basis of Ice Sheet Modeling. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. 1987. p 1-4, 6 ref.

Descriptors: *Glaciology, *Computer models, *Glaciohydrology, *Glaciers, *Ice, *Boundary conditions, *Model studies, *Ice sheets, Icebergs.

Verifiable ice sheet models are needed in order to interpret the past, to exploit the climatic information found in ice cores and to help interpret geological evidence of former glaciations. They are also needed to predict the future, to supplement ocean and atmospheric models for predicting changes in climate and sea level. As more realistic (i.e., complex) physics is incorporated in the ice sheet models, the number of adjustable parameters increases, making verification with a limited number of data values more difficult. Boundary conditions need to be carefully examined. The basal 'boundary condition' in many cases is expressed as a sliding function involving bedrock roughness and water pressure and probably also the flow of a till layer. Stating the physics of this process in a way that does not involve many arbitrarily adjustable parameters is a problem. The terminus 'boundary conditions' is also difficult to specify; the fact that terminus geometry depends on the ice dynamics complicates solution of such an initial boundary value problem. Many ice sheets ends in water; so that an uncertain iceberg calving function must be introduced; in at least one case it is shown that the calving function strongly influences the flow near the terminus. The greatest challenge, however, may be to obtain convincing verification of the model results. (See also W90-01886) (Author's abstract)
W90-01887

**IS THE CREEP OF ICE REALLY INDEPENDENT OF THE THIRD DEVIATORIC STRESS INVARIANT.**
Wisconsin Univ.-River Falls. Dept. of Plant and Earth Sciences.
R. W. Baker.
IN: The Physical Basis of Ice Sheet Modeling. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. 1987. p 7-16, 4 fig, 21 ref. NSF Grants No. EAR 77-12981 and EAR 79-01761.

Descriptors: *Rheology, *Glaciology, *Computer models, *Glaciohydrology, *Glaciers, *Shear stress, *Creep, *Ice sheets, *Model studies.

Samples of isotropic glacier ice were tested under conditions of simple shear with simultaneous uniaxial compression at a constant temperature to investigate the effects of stress configuration on ice rheology. Analysis of the experimental data failed to verify two fundamental assumptions inherent in Glen's flow law, that the deviatoric stress components and corresponding strain rate components are proportional and that secondary strain rates are independent of the third deviatoric stress invariant. Results suggest that stress configuration may effect the deformation of ice much more than that suggested by the flow law. (See also W90-01886) (Author's abstract)
W90-01888

**CRYSTALLINE FABRIC OF POLAR ICE SHEETS INFERRED FROM SEISMIC ANISOTROPY.**
Wisconsin Univ.-Madison. Geophysical and Polar Research Center.
D. D. Blankenship, and C. R. Bentley.
IN: The Physical Basis of Ice Sheet Modeling. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. 1987. p 17-28, 6 fig, 25 ref. NSF Grant No. DPP84-12404.

Descriptors: *Seismic studies, *Seismology, *Glaciology, *Computer models, *Ice, *Glaciohydrology, *Glaciers, *Antarctica, *Model studies, *Ice sheets, Seismic properties, Ice temperature, Crystallography.

In the future, an important parameter for modelling the dynamics of polar ice sheets will be the crystalline fabric of the constituent ice mass. Compressional (P) waves reflected at wide angles from the base of an ice sheet can be used to obtain a good approximation of both the mean fabric and mean temperature of that ice sheet. Seismic observations made in the vicinity of Dome C in East Antarctica show that the ice sheet there is transversely isotropic with a vertical axis of symmetry. Assuming the crystals' c-axes are distributed evenly within a vertical cone of apex angle I, the limiting fabric structures at Dome C are (1) half isotropic ice and half anisotropic ice with I = 0 degrees, and (2) all anisotropic ice with I = 29 degrees. On the basis of c-axis distributions measured in ice cores from other locations, the most reasonable structure at Dome C is one containing one-third isotropic ice and two-thirds anisotropic

ice with I = 20 degrees (corresponding to a total thickness of 3414 m). The seismically estimated mean temperature of the ice sheet (below the firn) is -38 degrees. (See also W90-01886) (Author's abstract)
W90-01889

**CONSTITUTIVE PROPERTIES OF ICE AT DYE 3, GREENLAND.**
Copenhagen Univ. (Denmark). Geophysical Inst.
D. Dahl-Jensen, and N. S. Gunderstrup.
IN: The Physical Basis of Ice Sheet Modeling. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. 1987. p 31-43, 5 fig, 2 tab, 31 ref. EEC XII Dir. Gen Contract No. CLI.067.DK.

Descriptors: *Glaciology, *Model studies, *Glaciohydrology, *Glaciers, *Greenland, *Ice sheets, Boreholes, Geologic history, Flow rates.

Inclinometer surveys of deep boreholes provide valuable information on the flow properties of modern ice (Holocene ice) and ice from the last glaciation (Wisconsin ice). The Dye 3 borehole on the south Greenland ice sheet has been surveyed seven times in the period 1981-1986. A least squares method has been used to derive the shear deformation rates directly from all the surveys. In the analysis, Glen's flow law has been used to calculate a flow law parameter from the shear deformation rates. Local stress fields due to the rough bedrock are used in these calculations; this has a large effect on the interpretation of the data. The results show that the Wisconsin ice flows a factor of three more readily than the Holocene ice. The enhanced flow is believed to be due primarily to the high concentration of dust and other impurities highly correlated with it and/or to the small crystal size. (See also W90-01886) (Author's abstract)
W90-01890

**ENHANCED FLOW OF WISCONSIN ICE RELATED TO SOLID CONDUCTIVITY THROUGH STRAIN HISTORY AND RECRYSTALLIZATION.**
Geological Survey of Canada, Ottawa (Ontario). Terrain Sciences Div.
D. A. Fisher.
IN: The Physical Basis of Ice Sheet Modeling. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. 1987. p 45-51, 4 fig, 1 tab, 12 ref.

Descriptors: *Rheology, *Recrystallization, *Glaciology, *Model studies, *Glaciohydrology, *Glaciers, *Isotopic tracers, *Ice sheets, Volcanoes, Crystallography, Canada.

Diameters of three holes in Agassiz Ice Cap, Ellesmere Island, Canada, have been logged annually, and the cores measured for delta(18)O and solid conductivity (ECM), an indicator of acid volcanic impurities. Enhanced flow of late Wisconsin ice as inferred from hole closure data, is negatively correlated with ECM attenuation. We suggest that over time, recrystallization concentrates the acid impurities into a quasi-liquid layer at grain boundaries, where they become neutralized. At the same time, increasing total strain developed a c-axis alignment. Both of these effects enhance the ice flow as a function of distance down the flow line. (See also W90-01886) (Author's abstract)
W90-01891

**MECHANICAL BEHAVIOR OF ANISOTROPIC POLAR ICE.**
Laboratoire de Glaciologie et Geophysique de l'Environnement, Saint-Martin d'Heres (France).
P. Pimienta, P. Duval, and V. Y. Lipenkov.
IN: The Physical Basis of Ice Sheet Modeling. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. 1987. p 57-66, 3 fig, 2 tab, 28 ref.

Descriptors: *Rheology, *Glaciology, *Model studies, *Glaciohydrology, *Glaciers, *Anisotropy, *Compressibility, *Ice sheets, Crystallography, Antarctica.

Uniaxial and biaxial compression tests on ice samples of the Vostok ice core (Antarctica) were carried out in order to study the flow behavior of anisotropic ice with c-axes in a vertical plane. Values of the rheological parameters involved in power law creep are given. It is deduced that the viscosity of Vostok ice for the thinning of annual layers is very high. Our results are compared with those obtained with ices with a single maximum fabric. Borehole tilting measurements were analyzed by taking into account the anisotropic power law creep. The possibility of a linear viscosity at low stresses is also considered. Regardless of the value of the exponent of the flow law, dislocation glide appears to be at the origin of the typical fabrics of polar ice. (See also W90-01886) (Author's abstract)
W90-01892

**FLOW VELOCITY PROFILES AND ACCUMULATION RATES FROM MECHANICAL TESTS ON ICE CORE SAMPLES.**
State Univ. of New York at Buffalo. Ice Core Lab.
H. Shoji, and C. C. Langway.
IN: The Physical Basis of Ice Sheet Modeling. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. 1987. p 67-77, 6 fig, 2 tab, 15 ref. NSF Grant No. DPP8520911.

Descriptors: *Ice sheets, *Glaciology, *Rheology, *Model studies, *Glaciohydrology, *Glaciers, *Greenland, Shear stress, Geologic history, Compressibility, Isotopic tracers.

Both the horizontal and vertical profiles at Dye 3, Greenland are calculated by using a strain rate enhancement factor profile obtained by making uniaxial compression tests on samples of the Dye 3 deep ice core. A 2-dimensional steady state laminar flow model is used to calculate the horizontal velocity profile. The vertical velocity profile is obtained from the horizontal velocity profile by applying the Dansgaard-Johnsen model. The depth-age relationship is calculated and compared with time-scales determined from delta(18)O, conductivity and dust measurements. The results indicate that the snow accumulation rate during late Wisconsin age was between 1/5 to 1/2 of the present day value. (See also W90-01886) (Author's abstract)
W90-01893

**CONTINUOUS TILL DEFORMATION BENEATH ICE SHEETS.**
Wisconsin Univ., Madison. Geophysical and Polar Research Center.
R. B. Alley, D. D. Blankenship, S. T. Rooney, and C. R. Bentley.
IN: The Physical Basis of Ice Sheet Modeling. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. 1987. p 81-91, 2 fig, 47 ref. NSF Grant No. DPP-8412404.

Descriptors: *Glaciology, *Model studies, *Glaciers, *Till, *Glacial drift, *Glacial sediments, *Ice sheets, Laurentide Ice Sheet, Glaciohydrology, Antarctica.

Either advance of a glacier over unconsolidated sediments or water-pressure fluctuations in unconsolidated subglacial sediments can trigger sediment deformation and changes in glacier flow and glacier-margin position without further climatic forcing. However, for a wet-based glacier beneath which bedrock erosion balances till transport by continuous subglacial deformation, internal instabilities are less likely and glacier changes that record climatic forcings are more likely. Evidence is presented here that the West Antarctic ice sheet is a modern example of such continuous till deformation, and that other ice sheets, including the Laurentide ice sheet, may have been similar. An ice sheet with continuous till deformation will leave a more regular sedimentary record than one with discontinuous deformation, so careful glacial-geological studies should allow distinction of these cases for former ice sheets. (See also W90-01886) (Author's abstract)
W90-01894

**ANOMALOUS HEAT FLOW AND TEMPERATURES ASSOCIATED WITH SUBGLACIAL WATER FLOW.**
Alaska Univ., Fairbanks. Geophysical Inst.
K. Echelmeyer.
IN: The Physical Basis of Ice Sheet Modeling. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. 1987. p 93-104, 4 fig, 3 tab, 10 ref.

Descriptors: *Glaciology, *Subglacial flow, *Model studies, *Ice sheets, *Glaciohydrology, *Glaciers, *Groundwater movement, Temperature effects.

Recent evidence suggests that many glaciers, ice streams, and ice sheets are underlain by a layer of till or other permeable, deformable medium. At some depth in this substratum there may be a flux of groundwater. Such a subglacial water flow will cause a shift in the melting isotherm below the polar ice mass. Calculations show that basal temperatures can be strongly elevated and that basal temperature gradients can be increased by more than an order of magnitude when there is a flux of groundwater through this subglacial aquifer, even though the upper part of the substratum is frozen. Comparison of calculated profiles with observed temperature data from cold-based glaciers shows favorable agreement. Such anomalous temperatures and heat flow will have important ramifications in the motion and dynamics of polar ice masses. Temporal fluctuations in the flux of subglacial water may also be an important means of incorporating subglacial debris into the glacier itself. (See also W90-01886) (Author's abstract)
W90-01895

**COUPLING BETWEEN WATER PRESSURE AND BASAL SLIDING IN A LINKED-CAVITY HYDRAULIC SYSTEM.**
Washington Univ., Seattle. Geophysics Program.
N. F. Humphrey.
IN: The Physical Basis of Ice Sheet Modeling. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. 1987. p 105-119, 3 fig, 21 ref. NSF Grant No. DPP 8408317.

Descriptors: *Rheology, *Glaciology, *Model studies, *Glaciohydrology, *Glaciers, *Stress, *Ice sheets, Flow, Water pressure.

Steady-state analysis of water and ice flow over a repeating three-dimensional pattern of bedrock steps, yields basic characteristics of a linked-cavity basal system. A force balance for the ice flow defines a pressure in the basal water system that depends only on the geometry of the bed and ice, and on the gradient of longitudinal stress in the ice. The pressure is independent of the water flux, degree of cavitation, and ice sliding speed. A model of the basal system is presented that includes force balances for ice and water flow, as well as an expression for the geometry of cavities in terms of sliding velocity and water pressure. The model demonstrates longitudinal stress-gradient coupling between the water and ice flow in a distributed linked-cavity system. For glaciers that are not uniform along the ice flow direction, coupling can lead to stationary waves in water pressure that are out of phase with sliding velocity. (See also W90-01886) (Author's abstract)
W90-01896

**ZONAL ARRANGEMENT OF THERMAL REGIMES OF PLEISTOCENE ICE SHEETS AS INDICATED BY FIELD DATA FROM POLAND.**
Silesian Univ., Katowice (Poland).
J. Liszkowski.
IN: The Physical Basis of Ice Sheet Modeling. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. 1987. p 121-130, 4 fig, 16 ref.

Descriptors: *Glaciology, *Model studies, *Glaciers, *Glacial drift, *Geologic history, *Ice sheets, Poland, Flow, Glaciohydrology.

Field observations from Poland indicate a radially distributed pattern of thermal regimes of Pleistocene ice sheets centered on the Scandinavian center of glaciation. Nearest the center of glaciation is a belt 500-750 km wide where the thermal regime of the ice sheet was cold. Hundreds of massive glacial rafts up to 10,000,000 cu m in volume were eroded from the pre-Quaternary bedrock. This belt comprises Pomerania and Masuria in north and north-east Poland. The ice flow regime was compressional here. Next is a 250 km wide zone where the thermal regime was temperate, ice movement was due to basal sliding, and the flow regime was extensional. This is reflected in the relatively faint bedrock erosion and low total thickness of Quaternary deposits, suggesting ineffective debris entrainment and glacial deposition. This zone comprises the central parts of the North German-Polish Plain. Within the marginal zones of individual ice sheets, the thermal regime was temperate, with large quantities of subglacial, englacial and supraglacial water. The ice flow regime was compressive. Rapid glaciofluvial deposition occurred in locally strongly differentiated environments. Push moraines and intensive glacio-tectonic deformations related to bedrock failure are common here. These observed patterns are related to bedrock geology and geohydrology and particularly to the different geothermal heat flow within different geotectonic units crossed by the ice sheets. (See also W90-01886) (Author's abstract)
W90-01897

**SLIDING OF COLD ICE SHEETS.**
Laboratoire de Glaciologie et Geophysique de l'Environnement, Saint-Martin d'Heres (France).
L. Lliboutry.
IN: The Physical Basis of Ice Sheet Modeling. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. 1987. p 131-143, 38 ref.

Descriptors: *Rheology, *Glaciology, *Model studies, *Glaciohydrology, *Glaciers, *Glacial erosion, *Glacial drift, *Ice sheets, Flow, Temperature effects.

When modelling ice sheet flow, a sliding law pertinent to the chosen space and time scales must be used. For studying glacial erosion and drift, the scale of the transition wavelength is relevant. Sliding laws corresponding to several models for ice rheology or bed microrelief are reviewed. The influence of the moisture content and permeability of temperate ice is studied. For cold ice sheets, four cases are distinguished. For modelling the flow of a mountain glacier, the sliding law has to be valid at the decametric scale. The model of a gently undulating profile with random roughness is favored; it leads to the prediction that sliding velocity is a single valued function of the drag and of the effective pressure. At the kilometric scale, the bottom may be at the melting point except at pinning that impede any sliding. On time scales longer than 1000 years, glacial erosion should be considered. Such erosion ends when all loose subglacial material has been carried away. (See also W90-01886) (Author's abstract)
W90-01898

**EFFECTS OF GLACIAL EROSION ON THE FLOW OF ICE SHEETS AND MORPHOLOGY OF THEIR BEDS.**
Akademiya Nauk SSSR, Moscow. Inst. Geografii.
V. L. Mazo.
IN: The Physical Basis of Ice Sheet Modeling. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. 1987. p 145-152, 3 fig, 19 ref.

Descriptors: *Glaciology, *Model studies, *Glaciohydrology, *Glaciers, *Glacial erosion, *Ice sheets, Geomorphology.

An important dynamic peculiarity of ice sheets is that their flow is channeled into a number of ice streams. Furthermore, ice sheet beds are dissected by large-scale longitudinal troughs, with ice streams being associated with those valley-like forms. The formation of both the ice streams and the large-scale longitudinal troughs is modelled by considering the coupling between the eroding ice sheet and its eroded bed. A stability analysis shows that small perturbations of the bed at certain wavelengths are stable while others are unstable. The latter develop into the ice streams and large-scale longitudinal troughs. Field data and calculations show that realistic flow models for ice sheets ought to consider three-dimensional geometrics, and erosion by ice sheets ought be taken into account for long-term ice sheet modelling. (See also W90-01886) (Author's abstract)
W90-01899

**FIT OF ICE MOTION MODELS TO OBSERVATIONS FROM VARIEGATED GLACIER, ALASKA.**
Washington Univ., Seattle. Geophysics Program.
C. F. Raymond, and W. D. Harrison.
IN: The Physical Basis of Ice Sheet Modeling. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. 1987. p 153-166, 6 fig, 2 tab, 40 ref.
NSF Grants Nos. EAR 7622463, EAR 7622500, EAR 7919424, and EAR 7919530.

Descriptors: *Glaciology, *Model studies, *Rheology, *Glaciers, *Creep, *Glacier surges, *Ice sheets, Flow, Alaska.

A test was made of how well models of ice deformation and sliding can be fit to the progressive evolution of geometry and velocity measured on Variegated Glacier during its normal phase of flow between surges. If there were no sliding motion, the observed changes require a progressive softening of the ice. Alternatively, if the creep law of ice were constant in time, a progressive increase in sliding rate is implied. Although the inferred sliding rate apparently varies directly with shear stress and inversely with estimated effective normal stress, no single quantitative relationship can be identified which can explain both the spatial pattern and time evolution. (See also W90-01886) (Author's abstract)
W90-01900

**WIND PUMPING: A POTENTIALLY SIGNIFICANT HEAT SOURCE IN ICE SHEETS.**
British Columbia Univ., Vancouver. Dept. of Geophysics and Astronomy.
G. K. C. Clarke, D. A. Fisher, and E. D. Waddington.
IN: The Physical Basis of Ice Sheet Modeling. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. 1987. p 169-180, 5 fig, 3 tab, 6 ref.

Descriptors: *Thermal regime, *Glaciology, *Model studies, *Glaciohydrology, *Glaciers, *Atmospheric pressure, *Firn, Friction, *Ice sheets, Heat, Arctic.

Atmospheric pressure fluctuations cause air to flow through permeable firn near the surface of an ice sheet. Viscous friction resulting from this flow could prove to be a significant heat source and may explain anomalous temperatures measured in Agassiz Ice Cap, Arctic Canada. The possible magnitude of this 'wind pumping' energy source was examined by assuming that air is an isothermal ideal gas and that air flux is governed by Darcy's law. Results show that pressure fluctuations in the frequency range 0.1-10 Hz are likely to have the greatest influence on the thermal regime of ice sheets and that under favorable conditions the disturbance to the 10 m temperature can exceed 3 degrees. A casual connection between wind pumping and the observed Agassiz Ice Cap temperature anomaly has yet to be established and indeed the results are counter-intuitive. Some entirely different explanation may prove correct but this issue cannot be settled without further field measurements. (See also W90-01886) (Author's abstract)
W90-01901

**RECONSTRUCTING MASS-BALANCE PROFILES FROM CLIMATE FOR AN ARCTIC ICE CAP.**
National Center for Atmospheric Research, Boulder, CO.
B. Hanson.
IN: The Physical Basis of Ice Sheet Modeling. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. 1987. p 181-189, 2 fig, 1 tab, 16 ref.

Descriptors: *Glaciology, *Model studies, *Glaciers, *Glacier mass balance, *Ice sheets, Arctic, Ice cover, Baffin Island, Glaciohydrology.

The mass balance of Barnes Ice Cap, Baffin Island, can be parameterized as a linear function of the mean summer temperature at Dewar Lakes. The mass balance rate over the ice cap increases linearly with elevation. The slope of the mass balance rate height function also increases linearly with summer temperature. These linear models can be used to extend the measured mass balance record of Barnes Ice Cap input to numerical models. Mass balance rates elsewhere in the Arctic probably follow similar rules, but the exact coefficients need to be adjusted for the individual situation. (See also W90-01886) (Author's abstract)
W90-01902

**EFFECT OF CREVASSES ON THE SOLAR HEATING OF A GLACIER SURFACE.**
Washington Univ., Seattle. Geophysics Program.
W. T. Pfeffer, and C. S. Bretherton.
IN: The Physical Basis of Ice Sheet Modeling. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. 1987. p 191-205, 3 fig, 1 tab, 17 ref.
NSF Grants Nos. ATM-86-05134 and DPP-77-22204.

Descriptors: *Ice sheets, *Glaciology, *Model studies, *Glaciers, *Solar radiation, *Thermal regime, *Crevasses, Glaciohydrology.

Accurate modelling of glacier flow involves solving coupled heat and mass flow equations which regime, among other conditions, heat flux boundary conditions at the surface. A model has been developed to estimate how much solar radiation a crevassed surface traps compared to a flat surface with the same reflectance properties. This effect is examined for a variety of crevasse opening angles, solar incidence angles, and surface reflectance properties. For various realistic choices of problem parameters the crevassed surface has been found to absorb than twice the radiation absorbed by a flat surface of equal horizontal area. (See also W90-01886) (Author's abstract)
W90-01903

**TIME DEPENDENT BOUNDARY CONDITIONS FOR CALCULATING OF TEMPERATURE FIELDS IN ICE SHEETS.**
Laboratoire de Glaciologie et Geophysique de l'Environnement, Saint-Martin d'Heres (France).
C. Ritz.
IN: The Physical Basis of Ice Sheet Modeling. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. 1987. p 207-216, 6 fig, 21 ref.

Descriptors: *Glaciology, *Model studies, *Glaciohydrology, *Glaciers, *Thermal regime, *Temperature effects, *Boundary conditions, *Ice sheets.

The time dependent heat equation was solved to study the influence of boundary conditions on temperature changes. To take into account the propagation of a temperature perturbation into the rock, it is necessary to perform the calculation both in the ice and rock. A sensitivity analysis indicates that a rock thickness of 1 to 2 km is sufficient. The effects of an accumulation rate change on the temperature are also studied. For this it is also necessary to account for ice thickness variations, which reduce the influence of accumulation rate perturbations. Because horizontal advection and strain heating vary when accumulation rate changes occur, a two-dimensional calculation is needed at each time step. (See also W90-01886) (Author's abstract)
W90-01904

**GEOTHERMAL HEAT FLUX BENEATH ICE SHEETS.**
Washington Univ., Seattle. Geophysics Program.
E. D. Waddington.
IN: The Physical Basis of Ice Sheet Modeling. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. 1987. p 217-226, 2 fig, 4 ref.

Descriptors: *Glaciology, *Model studies, *Glaciohydrology, *Glaciers, *Geothermal heat flux, *Ice sheets, Heat flow.

Ice sheet models must accurately calculate basal ice temperature. Sliding and potential loss of the oldest ice result where the basal temperature reaches the melting point. Basal ice temperature depends on geothermal heat flux, which cannot be easily measured. Due to variations in bedrock type and age, steady geothermal flux can vary by 50% over distances smaller than ice sheet dimensions. Basal heat flux also varies with time by up to 30% or more in response to climatic transient such as the 110 ka ice age cycle. Both surface mass balance and surface temperature influence the basal temperature regime, and ice sheet models must consider the thermal inertia of the bedrock. Ice dynamics can alter steady heat flow in the bed. The ice flow pattern typical of divides can reduce heat flow by 10% in the bedrock under the divide, and increase it by 2 to 3% under the flanks. Regions of longitudinal compression or extension or steep bedrock slope can also redirect steady geothermal heat flux in the bedrock. (See also W90-01886) (Author's abstract)
W90-01905

**ROLE OF LARGE-SCALE ICE SHEETS IN CLIMATE HISTORY.**
Bonn Univ. (Germany, F.R.). Meteorologisches Inst.
H. Flohn.
IN: The Physical Basis of Ice Sheet Modeling. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. 1987. p 231-241, 3 fig, 1 tab, 34 ref.

Descriptors: *Climatology, *Glaciology, *Model studies, *Glaciohydrology, *Glaciers, *Geologic history, *Ice sheets, Antarctica.

The climate history of the earth contains two periods of some 10 million years length during which a continent in polar latitudes was partly or totally glaciated, while the opposite hemisphere was essentially ice-free. The present glaciation of Antarctica started about 38 million years before the present preceding those of the northern continents by more than 30 million years. The climatogenetic role of this hemisphere asymmetry will be outlined, as well as the role of variations in the composition of the atmosphere. Together with the varying land-sea distribution in polar latitudes, atmospheric variations primarily control the climatic history of the planet Earth. (See also W90-01886) (Author's abstract)
W90-01906

**GLACIAL ISOSTASY AND THE ICE AGE CYCLE.**
Toronto Univ. (Ontario). Dept. of Physics.
W. R. Peltier, and W. T. Hyde.
IN: The Physical Basis of Ice Sheet Modeling. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. 1987. p 247-260, 16 fig, 18 ref.

Descriptors: *Glaciology, *Climatology, *Paleoclimatology, *Ice sheets, *Glaciohydrology, *Glaciers, *Geologic history, Isotopic tracers, Model studies.

On the basic of oxygen isotope data from deep sea sedimentary cores, it has recently been established that the variation of continental ice volume through the last 500,000 years of the Pleistocene period has been dominated by an oscillation of characteristic period, 100,000 years. Although several different models have been proposed to account for this phenomenon, the most successful have been those which coupled the physics of ice sheet accumulation and flow to the physics of glacial isostatic adjustment. When a sufficiently accurate description of the latter process is included in the model, the 100,000 year ice volume cycle is predicted as a nonlinear relaxation oscillation forced by the small fluctuations of summertime seasonal solar insolation that are produced by temporal variations of the parameters (eccentricity, obliquity, precession) that govern the geometry of the Earth's orbit around the sun. A review is provided of the properties of this climate model focusing upon the importance of the model's isostatic adjustment component. (See also W90-01886) (Author's abstract)
W90-01907

**SIMPLE SIMULATION OF ICE-ATMOSPHERE-OCEAN-LAND COUPLING IN CLIMATIC MODELS.**
National Center for Atmospheric Research, Boulder, CO.
S. H. Schneider, S. L. Thompson, and I. Muszynski.
IN: The Physical Basis of Ice Sheet Modeling. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. 1987. p 261-264, 13 ref.

Descriptors: *Climatology, *Ice sheets, *Glaciology, *Model studies, *Glaciohydrology, *Climatology, Ice-water interfaces.

Global climate models that attempt to incorporate fully the complex interactions between land, air, sea and ice are not very expensive computationally, but typically approximate certain types of interactions in an asynchronous manner; specifically, computational time steps are of different size for the different submodels within the complete climate model. A method of assessing possible errors in such a computational scheme is proposed that utilizes simplified models of the various climatic subsystems. (See also W90-01886) (Author's abstract)
W90-01908

**ICE SHEET ELEVATION CHANGES FROM ISOTOPE PROFILES.**
Washington Univ., Seattle. Quaternary Isotope Lab.
P. M. Grootes, and M. Stuiver.
IN: The Physical Basis of Ice Sheet Modeling. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. 1987. p 269-281, 5 fig, 1 tab, 33 ref.
NSF Grant No. DPP-84-00574.

Descriptors: *Glaciology, *Model studies, *Glaciology, *Glaciers, *Glacial drift, *Climatology, *Isotopic tracers, *Ice sheets, Antarctica, Geologic history.

The contributions of climate, ice sheet thinning, and ice flow to the total change in delta (delta(18)O or delta D) observed in Antarctic cores can be estimated by assuming (1) a uniform, climate-related delta change for Antarctica, based on the central East Antarctic Dome C core, and (2) different time constants for the three contributions. The approach, previously developed for the Ross Ice Shelf delta(18)O profile at J-9, is applied to the Law Dome and D-10 profiles. Evidently Law Dome was an independent dome during the last glacial period, because the surface elevation on Law Dome at which ice at the glacial-interglacial transition in core BHF originated decreased by about 530 m across the transition. Similarly about 1300 m of surface elevation lowering of the origin of ice across the glacial-interglacial transition is shown by the isotopic record in core D-10. (See also W90-01886) (Author's abstract)
W90-01909

**DERIVATION OF PALEOELEVATIONS FROM TOTAL AIR CONTENT OF TWO DEEP GREENLAND ICE CORES.**
Schlumberger-Doll Research Center, Ridgefield, CT.
S. L. Herron, and C. C. Langway.
IN: The Physical Basis of Ice Sheet Modeling. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. 1987. p 283-295, 9 fig, 32 ref.

Descriptors: *Climatology, *Glaciology, *Model studies, *Ice sheets, *Glaciohydrology, *Glaciers, *Paleoclimatology, *Greenland, Air entrainment.

The volume of air entrapped in polar ice at pore close-off is related to atmospheric pressure (elevation) and temperature. If a temperature history is known, elevation changes can be inferred. Laboratory measurements of air content in over 300 samples from two deep Greenland ice cores (from Camp Century and Dye 3) have been designed and interpreted so as to minimize the perturbations caused by short-term fluctuations in temperature and pressure, and by irregular cycles of melting and freezing. At Camp Century, Wisconsin air content is reduced by 8.5% relative to average Holocene values. If the Wisconsin air content originated close to Camp Century, the ice sheet must have been 500 m thicker during Wisconsin time. The elevation apparently changed gradually over an interval of several thousand years. At Dye 3, the intersample variability is higher, because each sample represents a smaller fraction of an annual layer, and the annual melt-percent is significantly greater. There is little or no difference in air content between Wisconsin and Holocene ice, implying that south central Greenland experienced little or no elevation change during the ice age. Due to the variability between ice cores from different locations, care must be taken in global interpretation of climate proxy data from a single core. (See also W90-01886) (Author's abstract)
W90-01910

**USE OF TRACE CONSTITUENTS TO TEST FLOW MODELS FOR ICE SHEETS AND ICE CAPS.**
Department of Energy, Mines and Resources, Ottawa (Ontario). Polar Continental Shelf Project.
N. Reeh, C. U. Hammer, H. H. Thomsen, and D. A. Fisher.
IN: The Physical Basis of Ice Sheet Modeling. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. 1987. p 299-310, 10 fig, 24 ref.

Descriptors: *Rheology, *Tracers, *Glaciology, *Model studies, *Glaciohydrology, *Glaciers, *Isotopic tracers, *Ice sheets, Flow, Greenland, Paleohydrology.

Variables such as the (18)0/(16)O ratio (delta(18)O), ice acidity, microparticle concentration, total gas content, and pollen content show large spatial and/or temporal variations when measured in the surface layers of the accumulation region of ice sheets and ice caps. If the ice comes to the surface in the ablation area or is recovered by ice core drilling, trace-elements concentrations may be used to link the ice to a specific site in the accumulation region and/or to a specific time of deposition, and hence provide data for testing ice-flow models. This paper presents delta(18)O data from surface samples collected on the margin of the Greenland ice sheet, which are used to link start and end points of flow lines. These data, when combined with ice-flow modelling, produce a delta-deviation record, displaying negative values back to 1-1.5 ka BP, and positive values in the period 1.5-6.3 ka PB, in accordance with the delta-variation found in ice-core records. This is taken as support for the modelling. Also, a method is described that allows experimental dating of the surface ice in the ablation zone by detecting the widths of the surfacing annual layers. Other possibilities for data the surface ice, e.g., by detecting acidity or delta marker horizons are also discussed. (See also W90-01886) (Author's abstract)
W90-01911

**CONSTRAINTS ON MODELS IN THE ROSS EMBAYMENT, ANTARCTICA.**
Wisconsin Univ., Madison. Geophysical and Polar Research Center.
C. R. Bentley.
IN: The Physical Basis of Ice Sheet Modeling.

International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. 1987. p 313-322, 2 fig, 30 ref. NSF Grant No. DPP 84-12404.

Descriptors: *Glaciology, *Ice sheets, *Rheology, *Model studies, *Glaciology, *Glaciers, *Ice streams, *Antarctic, Flow, Ross Embayment.

Numerical modelling of ice flow and evolution in the West Antarctic Ross Embayment system must treat a variety of physical characteristics that differ markedly through the system. Gravitational driving forces on the inland ice are balanced largely by the bed drag, but on the ice shelf and in the lower reaches of the ice streams, side drag appears to be dominant. The glacial system responds to applied forces in several ways. Bed deformation probably dominates under active ice streams, and may occur elsewhere under the inland ice, although to a lesser extent. Substantial uncertainties remain about the effective viscosity of a deforming subglacial layer. On the ice shelf Coulomb failure may provide a good model for differential motion across highly crevassed, boundary shear zones. Both the ice shelf and the grounded 'ice plain,' situated at the transition between ice stream and ice shelf, are characterized by longitudinal and/or transverse spreading. A goal of modelling should be to reproduce the strikingly transient behavior of the Ross ice streams, principally the stagnation of ice stream C some two centuries ago and the apparently rapid present-day expansion of ice stream B. (See also W90-01886) (Author's abstract)
W90-01912

**FORCE BALANCE OF RUTFORD ICE STREAM, ANTARCTICA.**
British Antarctic Survey, Cambridge (England).
For primary bibliographic entry see Field 7B.
W90-01913

**GEOLOGICAL EVIDENCE TO CONSTRAIN MODELLING OF THE LATE PLEISTOCENE RHONEGLETSCHER (SWITZERLAND).**
Eidgenoessische Technische Hochschule, Zurich (Switzerland). Versuchsanstalt fuer Wasserbau, Hydrologie und Glaziologie.
W. Haeberli, and C. Schluchter.
IN: The Physical Basis of Ice Sheet Modeling. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. 1987. p 333-346, 6 fig, 1 tab, 52 ref.

Descriptors: *Ice sheets, *Glaciology, *Model studies, *Glaciohydrology, *Glaciers, *Paleoglaciology, Switzerland.

By using the example of the Late Pleistocene Rhonegletscher in the Swiss Plateau, geological and geomorphological evidence about geometry, temperature, bed characteristics, water pressure, debris load and surface mass balance is discussed as a basis for reconstructing and modelling vanished glaciers. A relatively non-contradictory picture can be drawn for the ablation area around 18,000 yr B.P. However, realistic modelling of the ice body would require the application of a 3-dimensional, thermomechanically coupled system of time dependent ice and permafrost over the whole glacier area. This is made difficult by fundamental uncertainties about the ice geometry in the former accumulation area, about subglacial water pressures and sliding velocities, and about the appropriate time for the ice build-up. Qualitative rather than quantitative results can therefore be expected from model calculations in the foreseeable future. (See also W90-01886) (Author's abstract)
W90-01914

**LATE QUATERNARY DEGLACIATION OF THE AMUNDSEN SEA: IMPLICATIONS FOR ICE SHEET MODELLING.**
Maine Univ., Orono. Dept. of Geological Sciences.
T. B. Kellogg, and D. E. Kellogg.
IN: The Physical Basis of Ice Sheet Modeling. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. 1987. p 349-357, 5 fig, 18 ref. NSF Grant No. DPP-8020000.

Descriptors: *Sedimentology, *Paleontology, *Glaciology, *Model studies, *Glaciohydrology, *Glaciers, *Antarctic, *Paleoglaciology, *Ice sheets, Amundsen Sea, Melting.

Field observations and micropaleontological and sedimentological study of the previously unstudied Amundsen Sea continental shelf suggest the following preliminary conclusions bearing on glaciological modelling of the West Antarctic Ice Sheet: (1) the outer continental shelf is relatively shallow (360-460 m) with low relief, in contrast to the inner shelf where deep (>500 m), possibly glacially scoured, troughs occur. Troughs may represent former ice-stream channels. (2) Pine Island Bay cores are composed of silty mud with rare ice-rafted detritus (IRD) and microfossils, suggesting former ice-shelf cover consistent with observed rapid calving-margin recession of Pine Island Glacier. (3) Elsewhere, a thin (<15 cm) sandy mud overlies compact diamicton. In the eastern margin area this upper layer may result from the establishment of the Amundsen Sea polynya < 3000 years ago. (4) Grounded ice apparently advanced to the continental shelf margin, perhaps during the late Wisconsin, and grounded or shelf ice probably occupied the Amundsen Sea until recently. (See also W90-01886) (Author's abstract)
W90-01915

**OBSERVATION AT THE EDGE OF THE GREENLAND ICE SHEET: BOUNDARY CONDITION IMPLICATIONS OF MODELLERS.**
Aberdeen Univ. (Scotland). Dept. of Geography.
P. G. Knight.
IN: The Physical Basis of Ice Sheet Modeling. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. 1987. p 359-366, 4 fig, 14 ref.

Descriptors: *Ice sheets, *Glaciology, *Model studies, *Glaciohydrology, *Glaciers, *Isotopic tracers, *Boundary conditions, Greenland, Flow.

Basal ice sequences at the margin of the Greenland ice sheet reflect both marginal and interior basal processes, and have important boundary condition implications for modelling. Analysis of stable isotopes (delta-D, delta(18)O) and debris from the margin indicates two separate zones of debris entrainment beneath the ice; a zone of bulk adfreezing near to the margin, and a zone of warm bed regelation in the interior. Surface strain measurements indicate two predominant marginal flow regimes. Widespread compressive flow is accentuated during the winter by basal adfreezing, with major folding extending up to 1 km from the margin, and intense deformation in the extreme marginal zone giving rise to thick stacking of both marginally and interior derived basal layers. By contrast, where rapid streaming flow reaches the margin, extending flow predominates, and bottom melting removes the lower layers of the interior derived regelation ice. (See also W90-01886) (Author's abstract)
W90-01916

**DEVELOPMENT, DYNAMICS, AND DISSIPATION OF A LATE WISCONSIN ICE MASS OVER NORTHERN NEW ENGLAND.**
Cincinnati Univ., OH. Dept. of Geology.
T. V. Lowell, and P. E. Calkin.
IN: The Physical Basis of Ice Sheet Modeling. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. 1987. p 367-375, 5 fig, 1 tab, 11 ref.

Descriptors: *Glaciology, *Model studies, *Glaciohydrology, *Glaciers, *Glacial drift, *Ice sheets, *Laurentide Ice Sheet, Flow, New England, Entrainment.

Glacial striations, dispersed erratics, and landform distributions have allowed the behavior of a late-glacial ice mass over northern New England to be reconstructed. This ice mass was initiated as an arm of the Laurentide ice sheet but evolved to an isolated glacial dome. The behavior involved: (1) an initial ice-flow to the ESE that gave way to N and S flow; (2) an ice divide that migrated 120 km toward the SE; (3) an non-erosive area 20 to 100 km wide that was centered below the divide and moved with it; (4) entrainment, transport, and deposition of debris during the ESE flow, and primarily deposition during the later flows; (5) general, simultaneous stagnation over an ice mass on the order of 100 km wide. These inferred conditions will help calibrate future models of ice-flow that deal with mesoscale ice masses and changing flow conditions. (See also W90-01886) (Author's abstract)
W90-01917

**PROBLEMS OF TESTING ICE SHEET MODELS: A BRITISH CASE STUDY.**
Edinburgh Univ. (Scotland). Dept. of Geography.
A. J. Payne, and D. E. Sugden.
IN: The Physical Basis of Ice Sheet Modeling. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. 1987. p 377-380, 4 ref.

Descriptors: *Glaciology, *Ice sheets, *Glaciology, *Model studies, *Glaciohydrology, *Glaciers.

The problems of testing ice sheet models in the contest of a model of growth and decay of a former Scottish ice sheet are explored. A major problem concerns the number of assumptions made in order to achieve a realistic ice sheet model, for this makes it difficult to isolate the role of any one variable. One possible palliative to this problem is to adopt a critical rationalist viewpoint following the arguments of Karl Popper. This involves (a) recognition that meaning physical data cannot be accumulated unless related to a theory, (b) a view of a model as a hypothesis to be tested, and (c) the deliberate attempt to falsify the model (hypothesis) and to welcome a mismatch between model and reality. Critical tests of models are best achieved if the focus is on a restricted part of an ice sheet system where the role of individual variables may be isolated. (See also W90-01886) (Author's abstract)
W90-01918

## 2D. Evaporation and Transpiration

**ESTIMATING EVAPORATION FROM UTAH'S GREAT SALT LAKE USING THERMAL INFRARED SATELLITE IMAGERY.**
Brigham Young Univ., Provo, UT. Dept. of Civil Engineering.
W. Miller, and E. Millis.
Water Resources Bulletin WARBAQ, Vol. 25, No. 3, p 541-550, June 1989. USAF Office of Scientific Research Grant No. AFOSR-87-0177. 5 fig, 6 tab, 13 ref.

Descriptors: *Lake evaporation, *Great Salt Lake, *Infrared imagery, *Satellite technology, *Evaporation, Estimating, Pan evaporation, Saline lakes, Landsat images.

Water surface temperatures can be obtained from satellite thermal remote sensing. Landsat and other satellites sense emitted thermal infrared radiation on a regular basis over much of the earth's surface. Evaporation is accomplished by the net transport of mass from the water surface to the atmosphere. The evaporative transfer predominantly determines the water surface temperature. Hence, there should be good correlations between evaporation and surface temperatures. Previous investigations on Utah Lake with satellite-derived temperatures and pan and model-derived evaporation values have produced good correlations. However, more study was required with additional satellite data and evaporation measurements for saltwater conditions. The applicability of this method for estimating evaporation on Utah's Great Salt Lake was of particular interest at this time because of the unprecedented rise of this terminal lake Satellite thermal data and evaporation data from four different years were obtained for the Great Salt Lake and the surrounding region. More than 350 correlation and linear regression analyses were performed on the temperature and evaporation data. The lake salt concentrations were also factored into the analyses in several different ways. The correlation results were generally very good and a methodolo-

gy for using satellite-derived water surface temperatures along with salt concentrations was developed to estimate evaporation. (Author's abstract)
W90-00968

**ACCOUNTING FOR DISCREPANCIES IN PAN EVAPORATION CALCULATIONS.**
Everglades National Park, Homestead, FL. South Florida Research Center.
L. H. Gunderson.
Water Resources Bulletin WARBAQ, Vol. 25, No. 3, p 573-579, June 1989. 2 fig, 3 tab, 14 ref.

Descriptors: *Evaporation, *Instrumentation, *Data acquisition, *Pan evaporation, *Monitoring, Rainfall, Hydrologic data.

Four experiments were made to document and account for differences in evaporation data that were calculated using pans equipped with float-activated recorders and pans with hook gauge/rain gauge instrumentation. Paired in-pan comparisons indicted that evaporation differences were not due to the technique of measuring water level within the pan. Also, the recorder-float-lag did not account for the differences. By sampling rainfall events, it was found that evaporation pans and standard (8 in. orifice) rain gauges record significantly different amounts of rain, which results in differences in calculated evaporation on rainy days. Monitoring networks with evaporation pans should have uniform instrumentation that accurately records rainfall into the pans of consistent results. (Author's abstract)
W90-00972

**PASTURE EVAPOTRANSPIRATION UNDER VARYING TREE PLANTING DENSITY IN AN AGROFORESTRY EXPERIMENT.**
Griffith Univ., Nathan (Australia). School of Australian Environmental Studies.
For primary bibliographic entry see Field 3F.
W90-01224

**PRECARIOUSNESS OR EVEN THE LACK OF RECHARGE OF THE PHREATIC AQUIFER IN THE NORTH SAHELIAN AREA OF CHAD DURING THE LAST 26 YEARS (LA PRECARITE OU MEME L'ABSENCE D'ALIMENTATION DE LA NAPPE PHREATIQUE EN ZONE NORD-SAHELIENNE DU TCHAD. RESULTATS D'UN QUART DE SIECLE DE SURVEILLANCE PIEZOMETRIQUE).**
Bureau de Recherches Geologiques et Minieres, Orleans (France).
For primary bibliographic entry see Field 2F.
W90-01268

**MAPPING REGIONAL FOREST EVAPOTRANSPIRATION AND PHOTOSYNTHESIS BY COUPLING SATELLITE DATA WITH ECOSYSTEM SIMULATION.**
Montana Univ., Missoula. School of Forestry.
S. W. Running, R. R. Nemani, D. L. Peterson, L. E. Band, and D. F. Potts.
Ecology ECOLAR, Vol. 70, No. 4, p 1090-1101, August 1989. 5 fig, 57 ref. NASA Earth Science and Applications Div. Grant NAGW-952, Ames Res. Center Joint Res. Interchanges No. NCA2-27 and 2-138.

Descriptors: *Remote sensing, *Model studies, *Mapping, *Evapotranspiration, *Montana, *Coniferous forests, *Satellite technology, Topography, Vegetation, Spatial patterns, Field measurements, Model studies, Soil types, Climatic data.

Annual evapotranspiration (ET) and net photosynthesis (PSN) were estimated for a mountainous 28 x 55 km region of predominantly coniferous forests in western Montana. A simple geographic information system integrated topographic, soils, vegetation, and climatic data at a 1.1-km scale size defined by the satellite sensor pixel size. Leaf area index (LAI) of the forest was estimated with data from the NOAA (National Oceanic and Atmospheric Administration) Advanced Very High Resolution Radiometer (AVHRR). Daily microclimate of each cell was estimated from ground and satellite data and interpolated using MT-CLIM, a mountain microclimate simulator. A forest ecosystem simulation model, FOREST-BGC, was used to calculate ET and PSN daily for each cell. Ranges of estimated LAI (4-15), ET (25-60 cm/yr), and PSN (9-20 Mg/ha/yr) across the landscape follow the trends expected in both magnitude and spatial pattern. These estimates compared well with field measurements of related variables, although absolute validation of these predictions is not now possible at large spatial scales. (Author's abstract)
W90-01371

**TRANSPIRATION OF MATURE STANDS OF SPRUCE (PICEA ABIES (L.) KARST.) AS ESTIMATED BY THE TREE-TRUNK HEAT BALANCE METHOD.**
Vysoka Skola Zemedelska, Brno (Czechoslovakia). Inst. of Forest Ecology.
For primary bibliographic entry see Field 4D.
W90-01461

**MODELLING FOREST TRANSPIRATION FROM CLIMATOLOGICAL DATA.**
Groningen Rijksuniversiteit (Netherlands). Dept. of Physical Geography.
A. J. Dolman, and J. B. Stewart.
IN: Forest Hydrology and Watershed Management. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication No. 167, 1987. p 319-327, 4 fig, 2 tab, 14 ref, 1 append.

Descriptors: *Forest hydrology, *Transpiration, *Model studies, *Climatology, Soil water, Penman-Montieth equation.

A method is described which yields hourly meteorological values from climatological data. These hourly data are used to predict hourly forest transpiration with the Penman Monteith equation and an elaborate submodel of surface conductance. Comparison with measured values showed good agreement. The need for soil moisture measurements is removed by using a simple water balance model. Estimates of soil moisture deficits and transpiration for an 11 mo period showed good agreement with measured values. A comparison with simpler models of surface conductance showed the need to include both soil moisture and humidity feedbacks in models of surface conductance. (See also W90-01432) (Author's abstract)
W90-01462

**ESTIMATING WATER USE BY EUCALYPTUS GRANDIS WITH THE PENMAN-MONTEITH EQUATION.**
South African Forestry Research Inst., Sabie.
P. J. Dye.
IN: Forest Hydrology and Watershed Management. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication No. 167, 1987. p 329-337, 3 fig, 2 tab, 4 ref.

Descriptors: *Forest management, *Forest hydrology, *Transpiration, *Reforestation, *Eucalyptus trees, Penman-Montieth equation, South Africa.

A conflict exists in South Africa between the rising demands for both water and forest products from relatively small high rainfall regions. Detailed knowledge of transpiration from forest canopies is especially needed to predict the hydrological consequences of afforestation. The Penman-Monteith equation was used to estimate hourly transpiration from Eucalyptus grandis, the most widely planted hardwood species in South Africa. Micrometeorological data above the canopy were collected over one yr, and supplemented by stomatal conductance and leaf area data. Daily water use was estimated on 11 days when canopy conductance was measured, as well as over 57 dry winter days when canopy conductance could be estimated from ambient vapor pressure deficit. Mean daily water use over this period was calculated to be 4.7 mm. A sensitivity analysis of the Penman-Monteith equation on a typical winter day suggested that hourly transpiration can be predicted from ambient humidity with a high degree of accuracy. (See also W90-01432) (Author's abstract)
W90-01463

**SEASONAL VARIATION OF RADIATION AND ENERGY BALANCES IN A HINOKI STAND.**
Forest and Forest Products Research Inst., Kyoto (Japan). Kansai Branch.
S. Hattori.
IN: Forest Hydrology and Watershed Management. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication No. 167, 1987. p 349-357, 4 fig, 1 tab, 8 ref.

Descriptors: *Evapotranspiration, *Forest hydrology, *Solar radiation, *Energy, Seasonal variation, Hinoki, Japan.

The radiation and energy balances for 1980 over a 29-yr-old hinoki stand are presented. The total short-wave radiation received by the stand was partitioned as 10.7% reflected, 58.4% for the net radiation and -30.9% for the effective long-wave radiation on annual basis. The evapotranspiration was calculated by the energy balance Bowen ratio method for 114 days between April and October under the dry canopy condition. Averaged over the period, the net radiation in daytime was utilized for the evapotranspiration of 45.8% and the sensible heat flux of 54.2%, and the heat storage in the soil was negligibly small compared with other components. (See also W90-01432) (Author's abstract)
W90-01464

**USE OF LYSIMETER MEASUREMENTS FOR ESTIMATION OF THE EVAPOTRANSPIRATION OF PINE FOREST BY BAGROV'S METHOD.**
Humboldt-Univ. zu Berlin (German D.R.). Sektion Physik.
A. Helbig.
IN: Forest Hydrology and Watershed Management. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication No. 167, 1987. p 357-363, 2 fig, 2 tab, 9 ref.

Descriptors: *Forest hydrology, *Evapotranspiration, *Lysimeters, Pine trees, East Germany, Hydrologic budget.

With a nonweighing lysimeter (surface area 660 sq m, soil depth 4 m) near Magdeburg, East Germany, the components of water balance runoff R sub K and precipitation P sub K were measured for a pine forest (Pinus silvestris, 440 trees) since 1974, and yearly mean values of the evapotranspiration ET sub K were estimated. With advancing years the evapotranspiration ET sub K increased from 293.6 mm/yr (3 yrs old) to 528.8 mm/yr (14 yrs old). Simultaneously the evapotranspiration ET sub G for grass vegetation were measured by means of 12 weighing lysimeters. Up to the age of seven for the pine forest ET sub K < ET sub G was observed. Combined with the computation of the potential evapotranspiration ET sub p after Turc/Ivanov, the 'effectiveness parameter n sub K' after Bagrov based on quotients of smoothed monthly sums P sub K/ET sub p and ET sub K/ET sub p was estimated. Knowledge of these n sub K values allowed the calculation of yearly evapotranspiration sums of pine forests from P and ET sub p data taking into consideration their age. (See also W90-01432) (Author's abstract)
W90-01465

**RATIOS OF EDDY TRANSFER COEFFICIENTS OVER THE AMAZON FOREST.**
Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
Y. Viswanadham, L. D. de Abreu Sa, V. D. Silva Filho, and A. O. Manzi.
IN: Forest Hydrology and Watershed Management. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication No. 167, 1987. p 365-373, 2 fig, 1 tab, 13 ref.

Descriptors: *Meteorology, *Eddy diffusion, *Forest hydrology, *Evapotranspiration, *Amazon River, *Brazil.

Simultaneous profile and eddy flux data gathered over the Amazon forest, Brazil, have been analyzed to find values of the nondimensional functions phi sub M,HW and vertical eddy diffusivities K sub M,H,W (the subscripts M, H and W represent the parameters for momentum, heat and water vapor transfer). The ratios K sub H/K sub M and K sub H/K sub W are obtained from phi functions. The phi functions and ratios of eddy diffusivities are presented over a stability (Ri=Richardson number) range of -1.0<Ri<0.25. The results show: (1) in quasi-neutral conditions (-0.03<Ri<0.03), the inferred values of phi sub M, phi sub H and phi sub W are 1.28 +/-0.13, 0.53 +/-0.25 and 0.45 +/-0.15, respectively; (2) the ratios K sub H/K sub M, K sub W/K sub M and K sub H/K sub W are > unity in unstable, near neutral and slightly stable conditions; and (3) K sub H/K sub W is < unity for Ri>0.04. To account for the anomalies in K's, a brief discussion is presented based on turbulent transport processes. (See also W90-01432) (Author's abstract)
W90-01466

**SOIL WATER BALANCE MODEL FOR PARTITIONING WATER USE AMONG CROP TREES, EVAPORATION, AND COMPETING VEGETATION.**
Oregon State Univ., Corvallis. Dept. of Soil Science.
For primary bibliographic entry see Field 2G.
W90-01468

**SPATIAL AND TEMPORAL VARIABILITY OF RAINFALL AND POTENTIAL EVAPORATION IN TUNISIA.**
Lund Univ. (Sweden). Dept. of Water Resources Engineering.
For primary bibliographic entry see Field 2B.
W90-01545

**UNSATURATED FLOW INDUCED BY EVAPORATION AND TRANSPIRATION.**
Princeton Univ., NJ. Dept. of Civil Engineering and Operations Research.
For primary bibliographic entry see Field 2G.
W90-01598

**EVAPOTRANSPIRATION FROM URBAN AREAS.**
British Columbia Univ., Vancouver. Dept. of Geography.
T. R. Oke, H. Cleugh, and S. Grimmond.
IN: Hydrological Processes and Water Management in Urban Areas. Proceedings of the International Symposium 24-29 April 1988, Duisburg, West Germany. International Hydrological Programme of UNESCO Publication, 1988. p 107-112, 11 ref.

Descriptors: *Evapotranspiration, *Urban areas, *Urban hydrology, Water loss, Hydrologic budget, Energy balance, Mathematical models, Statistical models, Hydrometeorology.

Water losses from cities via evapotranspiration are almost ignored by traditional hydrology. This is attributable to the often reasonable assumption that this term is negligible during the storm events that tend to form a focus of attention in this field. A further reason is the difficulty of obtaining evapotranspiration measurements or estimates. With references to data gathered from modern energy and water balance field projects, it is shown that urban evapotranspiration can be evaluated using micrometeorological techniques. Models to determine the evapotranspiration flux for urban areas can be divided into two groups. First, those which consider evapotranspiration as one flux in the total surface energy balance. These are one-, two- and quasi-three-dimensional numerical boundary layer models. The convective fluxes are often partitioned using a static moisture availability factor or an assumed Bowen ratio. None have a been fully validated. The second group includes simple statistical algorithms and physically-based models utilizing hydrometeorological data as input. The latter includes the Penman-Monteith, advection-aridity and other forms of the Combination Model. These approaches potentially incorporate terms to account for either or all of the following factors: energy availability, atmospheric and surface vapor deficits, roughness effects, stomatal activity and boundary layer dynamics. Energy and water balance data sets gathered in Vancouver, B.C. are being used to test and develop such models for use in urban areas. (See W90-016012) (Lantz-PTT)
W90-01624

**FACTORS AFFECTING CROP COEFFICIENT WHEN CALCULATING CROP EVAPOTRANSPIRATION.**
Water Research Centre, Cairo (Egypt).
For primary bibliographic entry see Field 3F.
W90-01844

## 2E. Streamflow and Runoff

**UNCERTAINTY ANALYSIS OF RUNOFF ESTIMATES FROM A RUNOFF CONTOUR MAP.**
NSI Technology Services Corp., Corvallis, OR.
B. P. Rochelle, D. L. Stevens, and M. R. Church.
Water Resources Bulletin WARBAQ, Vol. 25, No. 3, p 491-498, June 1989. 5 fig, 4 tab, 16 ref.

Descriptors: *Runoff forecasting, *Hydrologic maps, *Uncertainty, *Rainfall-runoff relationships, *Acid rain effects, Watersheds, Computer models.

The U.S. Environmental Protection Agency (EPA) in cooperation with the U.S. Geological Survey (USGS) conducted an analysis to quantify the uncertainty associated with interpolating runoff to specific sites using a runoff contour map. Runoff was interpolated to 93 gaged watersheds from a runoff contour map using (1) hand interpolation to the watershed outlet, (2) a computer interpolation to the watershed outlet, and (3) hand interpolation to the watershed centroid. The interpolated values were compared to the actual gaged values and found that there was a bias in the average interpolated value for runoff estimated at basin outlets, with interpolated values being less than the actual. No significant difference was found between the hand interpolation method and the computer interpolation method except that the computer method tended to have higher variability due to factors inherent to the software used. There were no strong spatial correlations or regional patterns in the runoff interpolations, which indicates that there are no regional biases introduced in the development of the contour map. Runoff could be estimated, on the average, within approximately 8.9 cm (3.5 in; 15%) of the measured value using the three methods. The results of this work indicate that runoff contour maps can be used in regional studies to estimate runoff to ungaged systems with quantifiable uncertainty. (Author' abstract)
W90-00962

**EFFECT OF SULFOMETURON METHYL ON GROUND WATER AND STREAM QUALITY IN COASTAL PLAIN FOREST WATERSHEDS.**
Southeastern Forest Experiment Station, Gainesville, FL.
For primary bibliographic entry see Field 5B.
W90-00977

**AUTO-CAD-BASED WATERSHED INFORMATION SYSTEM FOR THE HYDROLOGIC MODEL HEC-1.**
Colorado State Univ., Fort Collins. Dept. of Zoology and Entomology.
T. J. Cline, A. Molinas, and P. Y. Julien.
Water Resources Bulletin WARBAQ, Vol. 25, No. 3, p 641-652, June 1989. 9 fig, 9 tab, 13 ref. US Army Research Grant no. ARO/DAAL 03-86-K-0175.

Descriptors: *Rainfall-runoff relationships, *Data storage and retrieval, *Hydrologic models, *Computer models, *Watersheds, *Model studies, *Watershed information system, *Computer-aided design, Information systems.

A microcomputer based Watershed Information System (W.I.S.) was developed to assist in the preparation of input files for the hydrologic simulation model HEC-1. This system consists of three phases. Phase I utilizes the capabilities of AutoCAD version 9 and three programs, BASINS, PLANES, and CHANNELS, to extract, organize, and display watershed data. Phase II uses the program CN to calculate some HEC-1 parameter values. Phase II utilizes the program HECUPDATE to create HEC-1 input files. The system input includes topographic, soils, land use, watershed geometry data, and a skeletal HEC-1 input file. Output from the system includes a summary User Reference File, a Soils File, a Land Use File, a Watershed Geometry File, a Curve Number File, and a HEC-1 input file, which is ready to run. The W.I.S. has been applied to Macks Creek Watershed in southwest Idaho. (Author's abstract)
W90-00980

**SAGEBRUSH RANGELAND HYDROLOGY AND EVALUATION OF THE SPUR HYDROLOGY MODEL.**
Agricultural Research Service, Boise, ID. Northwest Watershed Research Center.
B. P. Wilcox, C. L. Hanson, J. R. Wight, and W. H. Blackburn.
Water Resources Bulletin WARBAQ, Vol. 25, No. 3, p 653-665, June 1989. 9 fig, 4 tab, 34 ref.

Descriptors: *Rainfall-runoff relationships, *Hydrologic models, *Computer models, *Watersheds, *Model studies, *Sagebrush, Rangeland, Runoff, Idaho.

An excellent hydrologic record on sagebrush rangeland has been developed at the Reynolds Creek Experimental Watershed in southwestern Idaho. The objectives of this paper were two-fold: (1) to analyze and describe the hydrologic record (8-18 years) from four sagebrush watersheds (1-83 ha); and (2) to evaluate the hydrology components of SPUR (Simulation of Production and Utilization of Rangelands), a comprehensive rangeland model. The watersheds represents a gradient in elevation (1180-1658 m) and precipitation (240-350 mm/yr). Runoff was a small fraction (<2%) of the total water budget for all of the watersheds. It occurred very infrequently at the three lower elevation watersheds: Summit, Flats, and Nancy Gulch. At Lower Sheep, the highest elevation watershed, runoff occurred most years for a period of 1 to 17 weeks in the winter. Frozen soil combined with rainfall or snowmelt was associated with most of the runoff from Flats and Nancy Gulch. At Summit summertime thunderstorms produced all of the runoff. The average annual sediment yield from all of the watersheds was low (17-950 kg/ha). It was highest from Summit, which had well developed alluvial channels and very steep slopes. SPUR was able to simulate runoff with reasonable accuracy only at Summit, where frozen soils were not a factor. There was poor correlation between predicted and actual annual sediment loss. The model tended to over-predict evapotranspiration early in the growing season and under-predict it in the late summer. (Author's abstract)
W90-00981

**ANAEROBIC BIODEGRADATION OF POLYCHLORINATED BIPHENYLS IN HUDSON RIVER SEDIMENTS AND DREDGED SEDIMENTS IN CLAY ENCAPSULATION.**
New York State Dept. of Health, Albany. Wadsworth Center for Labs. and Research.
For primary bibliographic entry see Field 5B.
W90-00993

**ENERGY-FLOW RESPONSE MODELS FOR EVALUATION OF ALTERED RIPARIAN VEGETATION IN THREE SOUTHEAST ALASKAN STREAMS.**
Idaho Univ., Moscow. Dept. of Plant, Soil and Entomological Sciences.
For primary bibliographic entry see Field 2H.

W90-00994

**IMPACT OF HIGHWAY CONSTRUCTION ON LEAF PROCESSING IN AQUATIC HABITATS OF EASTERN TENNESSEE.**
Tennessee Technological Univ., Cookeville. Dept. of Biology.
For primary bibliographic entry see Field 4C.
W90-01016

**RIVER-GROUNDWATER RELATIONSHIPS IN THE LOWER PARTS OF THE NETHERLANDS.**
Rijksinstituut voor de Volksgezondheid en Milieuhygiene, Bilthoven (Netherlands).
For primary bibliographic entry see Field 2A.
W90-01019

**EVALUATION OF RAINFALL-DISCHARGE MODELS WITH DISCRIMINATION.**
University Coll., Galway (Ireland). Dept. of Engineering Hydrology.
M. H. Khan.
Journal of Hydrology JHYDA7, Vol. 108, No. 1-4, p 63-78, Jun 1989. 6 fig, 3 tab, 6 ref, append.

Descriptors: *Rainfall-runoff relationships, *Mathematical models, *Model studies, Rainfall-discharge models, Performance evaluation, Catchment areas.

Two techniques for evaluating model performance of rainfall-discharge models, between or above prescribed flow rates, are proposed. In the first, the range of the observed discharge is divided into bands, whose limits are defined in terms of fractions of the highest recorded peak. For a given band, the model performance is calculated considering only the observed discharge values occurring within that band, and comparing with the corresponding simulated discharges. In the other method, the model performance is evaluated by considering only the discharge values above each threshold level and the corresponding computed discharges. Within each band, or above each threshold, any standard criterion of fitting may be used. Although the model performances evaluated without discrimination of flow magnitudes are comparable in the two methods of fitting, the performances evaluated above the 45% threshold level are better in the second method than the first. The volumetric errors in both methods of fitting, as exhibited by RFV (ratio of (computed to observed) flow volumes), are mainly associated with low flow rates. This suggests where a modification of the model might be considered. (Sand-PTT)
W90-01020

**EVALUATION OF HYDROLOGICAL AND BIOLOGICAL INFLUENCES ON CO2 FLUXES FROM A KARST STREAM.**
Virginia Univ., Charlottesville. Dept. of Environmental Sciences.
K. J. Hoffer-French, and J. S. Herman.
Journal of Hydrology JHYDA7, Vol. 108, No. 1-4, p 189-212, Jun 1989. 11 fig, 3 tab, 33 ref. NSF grant EAR-84-17122.

Descriptors: *Geomorphology, *Hydrobiology, *Water chemistry, *Karst hydrology, *Geochemistry, *Travertine, *Calcite precipitation, *Carbon dioxide, Seasonal variation, Virginia, Streams.

CO2 exchange is the fundamental process that drives calcite precipitation in a spring-fed travertine-depositing stream located in Augusta County, Virginia. Groundwater issuing at the surface springs that feed the stream is supersaturated with respect to atmospheric CO2. CO2 flux along the stream is attributed to physical outgassing caused by the steep concentration gradient between CO2 dissolved in the stream water and its partial pressure in the atmosphere. The stream water is so rich in CO2 that biological cycling does not significantly alter the mass flux. Outgassing is enhanced by hydrological agitation at the cascades. The local flux of CO2 from the stream is greatest during the summer and fall. During those times, outgassing is driven by high dissolved CO2 concentrations in the streams, warm temperatures, and low stream discharge. Seasonally, variations in the net flux of CO2 from Falling Spring Run are minor. Outgassing drives the solution to high degrees of supersaturation with respect to calcite, yet calcite precipitation does not occur until the solution attains concentrations near 5 times supersaturation, high enough to overcome kinetic inhibition. Precipitation is greatest along the cascades where hydrological agitation drives rapid loss of CO2 and where benthic algal and moss mats and the travertine itself provide fresh surfaces for crystal growth. Calcite precipitation is greatest in the summer and fall when the local CO2 flux is greatest. (Author's abstract)
W90-01025

**USING HISTORICAL DATA IN NONPARAMETRIC FLOOD ESTIMATION.**
Waikato Univ., Hamilton (New Zealand). Dept. of Earth Sciences.
W. E. Bardsley.
Journal of Hydrology JHYDA7, Vol. 108, No. 1-4, p 249-255, Jun 1989. 2 fig, 1 tab, 10 ref.

Descriptors: *Flood forecasting, *Design floods, *Flood data, *Flood discharge, *Historic floods, *Paleohydrology, Yangtze River, China.

In recent years, a nonparametric approach to design flood analysis has emerged which is based on estimating the whole distribution of annual flood maxima from standard hydrological records. A simple modification is suggested for incorporating historical or paleoflood data as well. The resulting analysis is somewhat different from the parametric alternative in that it may not prove possible to estimate within a 'data gap' which may appear between the magnitudes of the largest modern floods and historical/paleoflood events. It is a matter of personal philosophy whether such gaps represent a true indication of the state of knowledge or are simply a disadvantage not experienced by parametric methods. An illustrative example is given using recent and historical flood data from the Yangtze River. (Author's abstract)
W90-01028

**GEOSTATISTICAL TOOL FOR DROUGHT MANAGEMENT.**
Georgia Inst. of Tech., Atlanta. School of Civil Engineering.
S. Rouhani, and K. A. Cargile.
Journal of Hydrology JHYDA7, Vol. 108, No. 1-4, p 257-266, Jun 1989. 4 fig, 1 tab, 12 ref. NSF grants ECE-8503897 and INT-8702264.

Descriptors: *Drought, *Water management, *Streamflow forecasting, *Reservoir operation, *Statistical methods, Georgia, Kriging.

Drought lead time is a useful tool to enable local reservoir operators to predict the possibility of the occurrence of a hydrological drought. Universal time kriging, a geostatistical technique, can be used to predict streamflows in low-flow seasons to yield an estimate of drought lead time for a given operating policy and initial conditions. This is an indicator of the severity of an approaching drought. The case study concerns a hypothetical reservoir in western Georgia. This area has experienced a number of drought periods in recent years. Using the actual and the estimated data, drought lead times for different initial storage values are calculated. The comparison indicates that the proposed procedure yields reliable estimates of drought lead time. (Author's abstract)
W90-01029

**DETERMINING RUNOFF ROUTING MODEL PARAMETERS WITHOUT RAINFALL DATA.**
Wollongong Univ. (Australia). Dept. of Civil and Mining Engineering.
M. J. Boyd, and M. C. Bufill.
Journal of Hydrology JHYDA7, Vol. 108, No. 1-4, p 281-294, Jun 1989. 5 fig, 5 tab, 12 ref.

Descriptors: *Routing, *Hydrologic models, *Model studies, *Runoff, *Rainfall-runoff relationships, *Streamflow, Storage reservoirs, Hyetographs, Mathematical models, Catchment areas.

When the parameters of runoff routing models are derived from recorded rainfall and streamflow data, the errors present in the data introduce uncertainty into the parameter estimates. Errors are likely to be greater in the rainfall record because it represents a point sample of the spatially varying rainfall, and subtraction of the assumed time-varying infiltration losses adds further error to the effective rainfall hyetograph. There are advantages, therefore, in determining the parameters from the streamflow record alone, without rainfall data. In some cases, where the catchment can be represented by a single reservoir, the parameters of the model can be determined directly from the hydrograph recession. Four methods for deriving the lag parameters of linear and nonlinear reservoirs from hydrograph recession are assessed using data from two small urban catchments. The methods were found to give consistent parameter estimates for each event. Parameters determined in this way are shown to give good reproduction of recorded hydrographs when applied to the effective rainfall hyetograph. (Author's abstract)
W90-01031

**MONTE CARLO COMPARISON OF PARAMETRIC AND NONPARAMETRIC ESTIMATION OF FLOOD FREQUENCIES.**
Ottawa Univ. (Ontario). Dept. of Civil Engineering.
K. Adamowski.
Journal of Hydrology JHYDA7, Vol. 108, No. 1-4, p 295-308, Jun 1989. 3 fig, 3 tab, 18 ref.

Descriptors: *Model studies, *Flood frequency, *Flood data, *Monte Carlo method, Frequency analysis, Comparison studies, Estimating.

The relationship of flood magnitude to frequency of occurrence can be estimated from observed annual flood data by the parametric method of fitting any of various theoretical distributions (e.g., Log-Pearson Type III) to the data, or by fitting the nonparametric method, which does not require a distributional assumption. The fixed and variable kernel nonparametric methods are investigated and compared using a Monte Carlo simulation technique. It is concluded that nonparametric methods are accurate, uniform, and particularly suitable for multimodal data. In addition, the variable kernel method provides more accurate estimates of the tail of a distribution. (Author's abstract)
W90-01032

**WATER CHEMISTRY AND ISOTOPE STUDY OF STREAMS AND SPRINGS IN NORTHERN CHILE.**
Weizmann Inst. of Science, Rehovoth (Israel). Dept. of Isotope Research.
For primary bibliographic entry see Field 2K.
W90-01034

**COMPOSITION AND SEASONAL VARIATIONS OF THE CHLOROPHYLLIC PIGMENT IN PHYTOBENTHOS ASSEMBLAGES OF THE TER RIVER OVER A NINE-MONTH PERIOD (COMPOSICION Y CICLO DE PIGMENTOS CLOROFILICOS EN LAS POBLACIONES DEL FITOBENTOS DEL RIO TER DURANTE UN PERIODO DE NUEVE MESES).**
Barcelona Univ. (Spain). Dept. de Ecologia.
For primary bibliographic entry see Field 2H.
W90-01056

**GEOCHEMICAL FEATURES OF THE TER RIVER WATERSHED (NE SPAIN).**
Barcelona Univ. (Spain). Dept. de Ecologia.
For primary bibliographic entry see Field 2K.
W90-01057

**SEASONAL OCCURRENCE OF CONIDIA OF AQUATIC HYPHOMYCETES (FUNGI) IN LEES CREEK, AUSTRALIAN CAPITAL TERRITORY.**
Canberra Coll. of Advanced Education, Belconnen (Australia). Water Research Centre.
For primary bibliographic entry see Field 2H.

W90-01066

**SOIL HYDROPHOBIC EFFECTS ON INFILTRATION AND CATCHMENT RUNOFF.**
Department of Primary Industries and Energy, Canberra (Australia). Bureau of Rural Resources.
For primary bibliographic entry see Field 2G.
W90-01072

**FIELD MEASUREMENT AND ASSOCIATED CONTROLLING FACTORS FOR GROUNDWATER SEEPAGE IN A PIEDMONT IMPOUNDMENT.**
Virginia Univ., Charlottesville. Dept. of Environmental Sciences.
For primary bibliographic entry see Field 2F.
W90-01073

**EXPERIMENTAL ANALYSIS OF RESERVOIR RELEASE WAVE ROUTING IN UPLAND BOULDER BED RIVERS.**
Birmingham Univ. (England). School of Earth Sciences.
D. J. Gilvear.
Hydrological Processes HYPRE3, Vol. 3, No. 3, p 261-276, Jul-Sep 1989. 12 fig, 3 tab, 9 ref.

Descriptors: *Routing, *Flood routing, *Regulated flow, *Reservoir releases, *Channel morphology, Flood forecasting, Dams, Flow characteristics.

Reservoir release wave routing during 33 controlled reservoir releases, along 15 upland boulder bed river channel reaches, on five different regulated rivers were monitored to assess the importance of river channel roughness and reservoir release magnitude on reservoir release wave speed. Wave speeds varied between 0.52 and 3.01 m/s. Reservoir release wave translation, steepening, and attenuation occurred. With high channel roughness values reservoir release wave arrival speed is retarded in comparison to peak stage and wave steepening occurs, but with a reduction in channel roughness reservoir release wave front arrival is accelerated producing attenuation. The threshold between reservoir release wave front attenuation and steepening occurs at a pre-release discharge/channel width of approximately 0.1, an index of channel roughness. Comparison of observed and calculated reservoir release wave speeds on the River Washburn, Yorkshire, indicated the difficulty of accurately predicting flood wave movement in upland boulder bed channels using existing prediction equations. The calculated values, however, revealed systematic error with pre-release discharge and reservoir release magnitude. Apparently the equations fail to account for the effects of high channel roughness together with pressure gradient forces, induced by rapid rates of stage change on the rising limb of reservoir releases. In order to predict reservoir release wave movement in regulated rivers accurately, hydraulic studies need to be undertaken and pre-release discharges prescribed to determine desired reservoir release wave routing behavior. Manipulation of the reservoir release pattern at the dam alone, cannot dictate reservoir release wave front form downstream or wave speed. (Author's abstract)
W90-01076

**MANAGEMENT AND CONTROL OF URBAN RUNOFF QUALITY.**
Middlesex Polytechnic, Enfield (England). Urban Pollution Research Center.
For primary bibliographic entry see Field 5G.
W90-01079

**EXPERIMENTAL ASSESSMENT OF RATES OF NITRATE REMOVAL BY RIVER BED SEDIMENTS.**
For primary bibliographic entry see Field 5B.
W90-01095

**EFFECT OF MINERAL SUBSTRATE HARDNESS ON THE POPULATION DENSITY OF EPILITHIC MICROORGANISMS IN TWO ONTARIO RIVERS.**
University of Western Ontario, London. Dept. of Geology.
For primary bibliographic entry see Field 2H.
W90-01113

**OPERATIONAL IMPLEMENTATION OF A FLOOD FORECAST (MISE EN OEUVRE OPERATIONNELLE D'UNE PREVISION DES CRUES).**
Ministere de l'Environnement, Neuilly-sur-Seine (France).
For primary bibliographic entry see Field 7C.
W90-01128

**FIRST DIAGNOSTICS OF A DRAINAGE AREA RELATING TO A FLOOD WARNING (PREMIERS DIAGNOSTICS D'UN BASSIN VERSANT POUR UNE ANNONCE DE CRUE).**
Montpellier-2 Univ. (France). Lab. d'Hydrologie Mathematique.
J. M. Masson.
La Houille Blanche HOBLAB, Vol. 5, No. 6, p 375-380, 1988. 1 tab, 6 ref. English summary.

Descriptors: *Flood forecasting, *Drainage area, *Rainfall-runoff relationships, *Flow rates, Flood flow, Rainfall intensity, Data acquisition, Hydrologic systems.

After underlining the importance and rapidity of floods depending on possible occurrences of heavy rainfall and the characteristics of the drainage area, the specific nature of various floods is examined. The inventory, acquisition and analysis of the available data, as well as a site inspection are necessary to specify the required and possible periods of time, as well as the time intervals to be taken into consideration. An ordinary hydrological method is proposed for forecasting the flow rates from rain. This method uses only two parameters from which it is possible to assess the variation depending on the scale and nature of the floods. (Author's abstract)
W90-01129

**STUDY CONCERNING THE RAPID FLOW OF FLOOD WATERS IN A SMALL CATCHMENT AREA OF A FORESTED ZONE IN BRITTANY (ETUDE DE LA FORMATION DE L'ECOULEMENT RAPIDE DE CRUE DANS UN PETIT BASSIN-VERSANT FORESTIER BRETON).**
Laboratoire de Geographie Physique, Meudon-Bellevue (France).
C. Cosandey.
La Houille Blanche HOBLAB, Vol. 5, No. 6, p 381-383, 1988. 2 fig, 1 tab, 12 ref. English summary.

Descriptors: *Rainfall-runoff relationships, *Surface-groundwater relations, *Forest watersheds, *Flood flow, *Brittany, *Groundwater level, Catchment basins, Water table, Flow rates, Saturation zone, Rainfall.

The relationship between the basic flow rate of a water course--which depends on the state of the groundwater table--and the significance of surface water are interpreted in various ways. Some authors place emphasis on the fact that the expansion of saturated zones at the bottom of the vale is conditioned by the groundwater table and others emphasize that the state of the groundwater table attests to the general state of the basin; namely the hydrologic reserve and the hydrous state of the soils. Studies conducted for three years in a small catchment basin in a forested granite area of Brittany have concluded that no Horton type surface irrigation exists on the valley flanks. The rapid flow of flood waters, therefore, is explained by rainfall in the saturated zones of the bottom vale whose expansion is directly connected to the state of the groundwater table. (Author's abstract)
W90-01130

**PRACTICAL COMPARISON OF FLOOD FORECAST METHODS. EXAMPLE OF THE AVEYRON RIVER (COMPARAISON PRATIQUE DE METHODES DE PREVISION DE CRUE. EXEMPLE DE L'AVEYRON).**
Centre National de la Recherche Scientifique, Toulouse (France). Inst. de Mecanique des Fluides.
For primary bibliographic entry see Field 7C.
W90-01131

**REAL TIME DECISION PROCEDURES RELATING TO FLOOD FORECASTING (LES PROCEDURES DE DECISION EN TEMPS REEL POUR LA PREVISION DES CRUES).**
Centre d'Enseignement et de Recherche pour la Gestion des Ressources Naturelles et l'Environnement, Paris (France).
For primary bibliographic entry see Field 7C.
W90-01132

**COMOD: SELECTOR SOFTWARE FOR DIFFUSING WAVE MODELS AND THEIR CHARACTERISTICS (C.O.M.O.D.: LOGICIEL DE CHOIX DE MODELES D'ONDES DIFFUSANTES ET DE LEURS CARACTERISTIQUES).**
Montpellier-2 Univ. (France). Lab. d'Hydrologie Mathematique.
For primary bibliographic entry see Field 7C.
W90-01135

**COMPUTERIZATION OF THE BACHET METHOD (INFORMATISATION DE LA METHODE BACHET).**
Laboratoire National d'Hydraulique, Chatou (France).
For primary bibliographic entry see Field 7C.
W90-01136

**PROPAGATION OF FLOODS WITH THE CONSTRAINED LINEAR SYSTEM (CLS). REAL TIME APPLICATION IN THE FORECAST INFORMATION SYSTEM (PROPAGATION DES CRUES AVEC LE CONSTRAINED LINEAR SYSTEM (CLS): APPLICATION EN TEMPS REEL DANS LE SYSTEME INFORMATIQUE DE PREVISION).**
LHF, 6, Rue de Lorraine, 38130 Echirolies, France.
For primary bibliographic entry see Field 7C.
W90-01137

**ADDITIONAL RESULTS CONCERNING THE SPATIAL DISTRIBUTION OF RAINFALL AND ITS ROLE IN THE TRANSFORMATION OF RAINFALL-RUNOFF (LA DISTRIBUTION SPATIALE DES PRECIPITATIONS ET SON ROLE DANS LA TRANSFORMATION PLUIE-DEBIT).**
Institut de Mecanique de Grenoble, Saint-Martin d'Heres (France).
For primary bibliographic entry see Field 2B.
W90-01140

**INFLUENCE OF ABIOTIC FACTORS AND DENSITY-DEPENDENT MECHANISMS ON BETWEEN-YEAR VARIATIONS IN A STREAM INVERTEBRATE COMMUNITY.**
Facultes Universitaires Notre-Dame de la Paix, Namur (Belgium). Unite d'Ecologie des Eaux Douces.
For primary bibliographic entry see Field 2H.
W90-01153

**DIEL ACTIVITY OF GAMMARUS PULEX (CRUSTACEA) IN A SOUTH SWEDISH STREAM: COMPARISON OF DRIFT CATCHES VS BAITED TRAPS.**
Maryland Univ., College Park. Dept. of Zoology.
For primary bibliographic entry see Field 2H.
W90-01156

**UPSTREAM MIGRATION BY THE INVASIVE SNAIL, PHYSA ACUTA, IN CAPE TOWN, SOUTH AFRICA.**
Natal Univ., Pietermaritzburg (South Africa). Dept. of Zoology.
For primary bibliographic entry see Field 2H.
W90-01169

**ESTIMATION OF THE SURFACE RUNOFF AND ITS SUSPENDED LOAD IN SOME MAJOR WORLD RIVER BASINS (ESTIMATION DE L'ECOULEMENT SUPERFICIEL ET DE SA CHARGE EN SUSPENSION SUR QUELQUES GRANDS BASSINS FLUVIAUX DU MONDE).**
Centre National de la Recherche Scientifique, Strasbourg (France). Centre de Sedimentologie et de Geochimie de la Surface.
J.-L. Probst, and N. Sigha.
Comptes Rendus de l'Academie des Sciences (Serie 2) CRASEV, Vol. 309, No. 4, p 357-363, June 1989. 1 tab, 30 ref.

Descriptors: *River basins, *Rivers, *Surface runoff, *Sediment load, *Fourier analysis, Sediment transport.

Twenty-six major world rivers were examined to estimate the yearly average contribution of the surface runoff to the river discharge, using the spectral analysis of Fourier applied to the time series of mean monthly discharges. The river-suspended sediment transports were used to calculate the concentration in surface runoff. On a global scale, these results allow assessment of the surface runoff intensity over the entire world and the calculation of its suspended load. (Author's Abstract)
W90-01174

**DIEL FLUCTUATIONS IN BACTERIAL ACTIVITY ON STREAMBED SUBSTRATA DURING VERNAL ALGAL BLOOMS: EFFECTS OF TEMPERATURE, WATER CHEMISTRY, AND HABITAT.**
Academy of Natural Sciences of Philadelphia, Avondale, PA. Stroud Water Research Center.
For primary bibliographic entry see Field 2K.
W90-01187

**NUTRIENT CONCENTRATION-STREAM DISCHARGE RELATIONSHIPS DURING STORM EVENTS IN A FIRST-ORDER STREAM.**
Bucknell Univ., Lewisburg, PA. Dept. of Biology.
For primary bibliographic entry see Field 2H.
W90-01276

**DETERMINATION OF NUTRIENT UPTAKE KINETIC PARAMETERS: A COMPARISON OF METHODS.**
British Columbia Univ., Vancouver. Dept. of Oceanography.
For primary bibliographic entry see Field 2H.
W90-01290

**LITTER CONSUMPTION BY INVERTEBRATES FROM AN AUSTRALIAN TROPICAL RAINFOREST STREAM.**
James Cook Univ. of North Queensland, Townsville (Australia). Dept. of Zoology.
For primary bibliographic entry see Field 2H.
W90-01303

**EPILITHIC ALGAL COMMUNITIES FROM RIVER SEGURA BASIN, SOUTHEASTERN SPAIN.**
Murcia Univ. (Spain). Dept. de Biologia Vegetal.
For primary bibliographic entry see Field 2H.
W90-01304

**GROWTH OF MACROPHYTES AND ECOSYSTEM CONSEQUENCES IN A LOWLAND DANISH STREAM.**
Copenhagen Univ., Hilleroed (Denmark). Det Ferskvands-Biologiske Lab.
For primary bibliographic entry see Field 2H.
W90-01315

**DECOMPOSITION OF LEAF LITTER EXPOSED TO SIMULATED ACID RAIN IN A BUFFERED LOTIC SYSTEM.**
Calgary Univ. (Alberta). Aquatic Ecology Section.
For primary bibliographic entry see Field 5C.
W90-01316

**MACROINVERTEBRATE MOVEMENTS IN A LARGE EUROPEAN RIVER.**
Lyon-1 Univ., Villeurbanne (France). Lab. d'Ecologie des Eaux Douces.
For primary bibliographic entry see Field 2H.
W90-01317

**EXPERIMENTAL COLONIZATION OF SAND, GRAVEL AND STONES BY MACROINVERTEBRATES IN THE ACHERON RIVER, SOUTHEASTERN AUSTRALIA.**
Monash Univ., Clayton (Australia). Dept. of Zoology.
For primary bibliographic entry see Field 2H.
W90-01318

**ADSORPTION AND RELEASE OF AMINO ACIDS FROM EPILITHIC BIOFILMS IN STREAMS.**
Mount Allison Univ., Sackville (New Brunswick).
For primary bibliographic entry see Field 2H.
W90-01324

**HYDROCHEMICAL CHARACTERIZATION OF ALPINE AND ALPINE-SUBALPINE STREAM WATERS, COLORADO ROCKY MOUNTAINS, U.S.A.**
Colorado State Univ., Fort Collins. Dept. of Earth Resources.
For primary bibliographic entry see Field 2K.
W90-01339

**CLUSTER ANALYSIS AS APPLIED TO REGIONAL FLOOD FREQUENCY.**
Manitoba Univ., Winnipeg. Dept. of Civil Engineering.
D. H. Burn.
Journal of Water Resources Planning and Management (ASCE) JWRMD5, Vol. 115, No. 5, p 567-582, September 1989. 4 fig, 3 tab, 11 ref, append.

Descriptors: *Flood frequency, *Flood basins, *Statistics, *Network design, Flood plain management, On-site data collections, Data transmission, Flood data, Flood recurrence interval, Flood flow, Flood profiles, River basins, Model studies, Model testing, Mathematical studies, Algorithms, Homogeneity, Canada.

A statistical technique for delineating groups of stations to be considered a region for regional flood frequency analysis is presented. The technique, which utilizes cluster analysis, allows the inclusion of a diversity of factors which might be considered to be of relevance when seeking stations in differing basins having similar extreme flow characteristics. The method incorporates both a basin similarity measure, imbedded in the clustering algorithm, and a regional homogeneity measure used to evaluate station partitionings obtained from the clustering algorithm. The result is that groups of stations are identified that can be considered sufficiently homogeneous to effect an efficient spatial data transfer. The methodology was applied to rivers in southern Manitoba, Canada, and illustrates pertinent aspects of the procedure. (Author's abstract)
W90-01344

**HYDRAULIC GEOMETRY OF STREAMS AND STREAM HABITAT ASSESSMENT.**
Illinois State Water Survey Div., Champaign. Surface Water Section.
K. P. Singh, and S. M. Broeren.
Journal of Water Resources Planning and Management (ASCE) JWRMD5, Vol. 115, No. 5, p 583-597, September 1989. 5 fig, 4 tab, 7 ref, append.

Descriptors: *Hydraulic geometry, *Stream fisheries, *Streamflow forecasting, *Aquatic habitats, *Stream discharge, Ponds, Riffles, Dams, Water depth, Flow velocity, Fish, Channel morphology, Model studies, Model testing, Basins, Drainage systems, Probabilistic process.

Natural streams have riffles and pools even in straight reaches. The riffles act as dams holding the water in the pools behind them. With a decrease in streamflow, the relative differences in depths and velocities at the riffles and pools increase. These differences afford suitable habitats for various fish species in their various life stages. Some hydraulic characteristics of stream channels vary with discharge. Quantification of the relationship between stream discharge and the availability of suitable aquatic habitat requires detailed information on the values of local depths and velocities as they vary through riffles and pools. A basin model is presented which provides a new approach to basinwide flow modeling for stream habitat evaluation. Streams within a basin exhibit similar patterns of development, varying in scale with the drainage area. Average width, depth, and velocity increase in a predictable way with drainage area and discharge. Hydraulic geometry relations define the average values of width, depth, and velocity for any stream in the basin. Local variations of depth and velocity about the average are evaluated from probability distribution models developed from field measurements made throughout riffle and pool sequences. The basin flow model provides the needed hydraulic data to apply the Instream Flow Incremental Methodology (a state-of-the-art methodology for stream habitat evaluation) of the U.S. Fish and Wildlife Service. (Author's abstract)
W90-01345

**BEDLOAD TRANSPORT OF MUD AS PEDOGENIC AGGREGATES IN MODERN AND ANCIENT RIVERS.**
Ottawa Univ. (Ontario). Dept. of Geology.
For primary bibliographic entry see Field 2J.
W90-01359

**RESOLUTION CONSIDERATIONS IN USING RADAR RAINFALL DATA FOR FLOOD FORECASTING.**
Waterloo Univ. (Ontario). Dept. of Chemical Engineering.
For primary bibliographic entry see Field 2B.
W90-01365

**INFLUENCE OF RIPARIAN VEGETATION ON THE FUNCTIONAL ORGANIZATION OF FOUR HONG KONG STREAM COMMUNITIES.**
Hong Kong Univ. Dept. of Zoology.
For primary bibliographic entry see Field 2H.
W90-01373

**PROPOSAL FOR MODIFICATION OF THE BELGIAN BIOTIC INDEX METHOD.**
Antwerp Univ., Wilrijk (Belgium). Dept. of Biology.
For primary bibliographic entry see Field 5A.
W90-01374

**PRODUCTION ESTIMATES OF THE DOMINANT TAXA OF CHIRONOMIDAE (DIPTERA) IN THE MODIFIED, RIVER WIDAWKA AND THE NATURAL, RIVER GRABIA, CENTRAL POLAND.**
Lodz Univ. (Poland). Inst. of Environmental Biology.
For primary bibliographic entry see Field 2H.
W90-01375

**ESTIMATION OF RIVER FLOOD DISCHARGES USING THE COMPUTER PROGRAM HYFA.**
International Inst. for Hydraulic and Environmental Engineering, Delft (Netherlands).
M. Shahin.
IN: Computer Methods and Water Resources: First International Conference, Morocco, 1988. Vol. 3, Computational Hydrology. Computational Mechanics Publications, Boston. 1988. p 75-85, 3 fig, 3 tab, 10 ref.

Descriptors: *Model studies, *Streamflow forecasting, *Computer programs, *Computer models, *Hydrologic models, *Flood discharge, *Flood frequency, *Flood forecasting, Spillways, Fre-

quency analysis, Frequency distribution, Hydrologic properties, Flood plain management.

HYFA is a computer program helping the user to solve hydrological problems containing some aspects of frequency analysis. This is achieved by enabling the user to steer the program via menu options and via replies to various interactive questions. The program first evaluates the basic statistical descriptors for the input data. Secondly, it computes the parameters of some continuous frequency distribution.s Distribution parameters are fitted to the input series by the method of moments and maximum likelihood. HYFA estimates the T-year event magnitude, its standard error of estimate and confidence limits for selected return periods. HYFA's third feature is the goodness of fit measured through the chi-square and deviation tests. The program has been applied to the annual flood series of six African rivers. Flood discharges for return periods other than the length of the input series have been computed and their confidence limits estimated. (See also W90-01409) (Author's abstract)
W90-01416

**COMPUTER MODELS OF CATCHMENT RUNOFF.**
Krakow Technical Univ. (Poland). Inst. of Water Engineering.
B. Wiezik.
IN: Computer Methods and Water Resources: First International Conference, Morocco, 1988. Vol. 3, Computational Hydrology. Computational Mechanics Publications, Boston. 1988. p 97-103, 2 fig, 5 ref.

Descriptors: *Computer programs, *Computer models, *Rainfall-runoff relationships, *Catchment areas, *Model studies, *Runoff, *Comparison studies, Computers, Mathematical models, Hydrologic models.

A package of computer programs called IDERUM (Identification of Runoff Models) is presented for some selected models of catchment runoff. The programs can be run interactively on a personal computer. Linear and nonlinear mathematical models that differ from each other in number of optimized parameters have been used to describe the runoff process. IDERUM has a modular structure that can be extended and adjusted to meet the actual requirements of runoff simulation and forecasting. Usage of IDERUM reduces the process of identification and gives an opportunity to compare the results produced by different models. Modular structure of the program allows its extension by adding new models of effective rainfall and new models of rainfall/runoff transformation. (See also W90-01409)(Author's abstract)
W90-01418

**ORIENTED COMPUTER APPROACHES OF NORMAL ERROR DISTRIBUTION.**
Agriculture and Water Resources Research Centre, Baghdad (Iraq). Dept. of Water Resources.
For primary bibliographic entry see Field 7C.
W90-01420

**PREDICTION OF CYCLIC RAINFALL AND STREAMFLOW.**
University of the Witwatersrand, Johannesburg (South Africa). Water Systems Research Programme.
For primary bibliographic entry see Field 2B.
W90-01422

**STOCHASTIC METHODS AND RELIABILITY ANALYSIS IN WATER RESOURCES.**
Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
For primary bibliographic entry see Field 7C.
W90-01424

**STOCHASTIC SIMULATION OF MONTHLY AVERAGE FLOW FOR RIVERS IN DRY OR SEMI-DRY CLIMATES (SIMULATION STOCHASTIQUE DE DEBITS MOYENS MENSUELS DANS LE CAS DE RIVIERES EN CLIMAT ARIDE OU SEMI-ARIDE).**
Universite Catholique de Louvain, Louvain-la-Neuve (Belgium). Faculte des Sciences Appliquees.
A. Bouziane, G. de Ghellinck, and Y. Zech.
IN: Computer Methods and Water Resources: First International Conference, Morocco, 1988. Vol. 3, Computational Hydrology. Computational Mechanics Publications, Boston. 1988. p 231-241, 4 tab, 24 ref. No English summary.

Descriptors: *Streamflow forecasting, *River flow, *Model studies, *Stochastic hydrology, Semiarid climates, Arid climates, Morocco, Meuse River.

A method for selecting a stochastic simulation model of the average monthly flow for rivers is proposed. The method was applied to the rivers of Morocco and to the Meuse River in Belgium. Problems in choosing a model are considered including such factors as identifying the type of model, identifying the form of the model, estimating the model parameters, testing the adequacy of the model, and evaluation its uncertainties. The procedures of modelling using an ARMA model is summarized. The model was applied to seven rivers in Morocco: Ourika, Kensera, Rhoress, Khenifra, Dechra, Taourirt, and Zat; and to the Meuse in Belgium. The results showed that the flow of the Moroccan rivers is relatively very variable from month to month while that of the Meuse is more constant. (See also W90-01409) (Peters-PTT)
W90-01427

**STOCHASTIC MODELING OF THE DAILY FLOWS IN THE RIVER CRATI, SOUTHERN ITALY.**
Universita di Reggio Calabria, Cosenza (Italy).
C. Colosimo, V. A. Copertino, and G. D'Ippolito.
IN: Computer Methods and Water Resources: First International Conference, Morocco, 1988. Vol. 3, Computational Hydrology. Computational Mechanics Publications, Boston. 1988. p 257-274, 19 fig, 12 ref.

Descriptors: *Stochastic models, *Streamflow forecasting, *Model studies, *Mathematical models, *Italy, *Deterministic models, *Hydrologic models, Daily hydrographs, Hydrologic properties, Flow characteristics, Flow profiles, Probability distribution, Streamflow.

Two different approaches can be used to generate the synthetic series in the modeling of daily flows for river dynamics measurement and water management, The first consists in simulating the single processes that occur in hydrological basins, after which they are correlated by means of mathematical equations. The second approach used historical data that are correlated with no reference to the particular hydrological process involved. This latter approach can be divided into two components, the deterministic and the stochastic. If an autoregressive model is then applied to the stationary stochastic process, the independent stochastic component is found, of which it is possible to determine the probability distribution. To obtain the various components, both the correlogram and the variance density spectrum are employed. Together, they provide indications concerning the periodic component and the particular autorregressive model to be adopted for the dependent stochastic component. An autoregressive model was applied to the daily flows in the river Crati, Italy, for the years 1926-1951. With investigations concerning the separation of individualization of the probability distribution for the residues obtained, it would be possible to complete the mathematical model for the representation of the daily flows of the river. (See also W90-01409)(Friedmann-PTT)
W90-01429

**REGIONAL FLOOD DISTRIBUTION MODEL FOR SKEWED DATA.**
Pontificia Univ. Catolica de Chile, Santiago. Faculty of Engineering.
E. A. Varas, and T. J. Jolley.
IN: Computer Methods and Water Resources: First International Conference, Morocco, 1988. Vol. 3, Computational Hydrology. Computational Mechanics Publications, Boston. 1988. p 275-285, 5 tab, 4 ref.

Descriptors: *Model studies, *Statistical models, *Regional floods, *Flood frequency, *Flood hydrographs, *Hydrologic models, *Statistical analysis, Poisson ratio, Catchment areas, Flood flow, Flood recurrence interval, Model studies, Chile, Hydrologic data.

The two component extreme value distribution is presented as a convenient regional flood model in cases of highly skewed flows. The two-component extreme value (TCEV) distribution arises as a mixture of two distributions representing the maximum values of a Poisson compound process. Maximum likelihood and probability weighted moments methods were used for parameter estimation. A regional TCEV model representative of annual flood series in central and southern Chile is presented and a comparison with observed flows is made. The methods were shown to be satisfactory in the majority of cases, but problems of convergence were encountered in some samples with low skew coefficients. In these cases, the TCEV distribution became an extreme value I (EVI) distribution, implying that it is possible to devise an a priori test to determine whether or not the TCEV distribution is an appropriate model to use. The comparison of the TCEV fit to that of other distributions is still restricted to the limitations of goodness of fit tests, but within these limitations, it would seem a good choice of distribution for catchments with high skews. Regional flood frequency curves are particularly useful in cases where observed data is scarce. (See also W90-01409) (Friedmann-PTT)
W90-01430

**FOREST HYDROLOGY AND WATERSHED MANAGEMENT.**
For primary bibliographic entry see Field 4D.
W90-01432

**INFLUENCE OF ACID PRECIPITATION ON STREAM CHEMISTRY IN A SMALL FORESTED BASIN IN SOUTHWESTERN BRITISH COLUMBIA.**
British Columbia Univ., Vancouver. Faculty of Forestry.
For primary bibliographic entry see Field 5B.
W90-01436

**ACID BUFFERING IN LOWLAND FORESTED ECOSYSTEMS: A CASE STUDY IN THE TRENT BASIN, UK.**
Coventry (Lanchester) Polytechnic (England). Dept. of Geography.
For primary bibliographic entry see Field 5B.
W90-01437

**STREAM ACIDIFICATION RESULTING FROM AFFORESTATION IN THE UK: EVALUATION OF CAUSES AND POSSIBLE AMELIORATIVE MEASURES.**
Institute of Terrestrial Ecology, Bangor (Wales). Bangor Research Station.
For primary bibliographic entry see Field 5B.
W90-01438

**CONTRIBUTIONS OF ACID DEPOSITION TO STREAMWATER CHEMISTRY IN THREE PRECAMBRIAN SHIELD BASINS.**
Great Lakes Forestry Research Centre, Sault Sainte Marie (Ontario).
For primary bibliographic entry see Field 5B.
W90-01440

**SOURCES OF ACIDITY DURING SNOWMELT AT A FORESTED SITE IN THE WEST-CENTRAL ADIRONDACK MOUNTAINS, NEW YORK.**
Geological Survey, Doraville, GA.
For primary bibliographic entry see Field 5B.
W90-01441

**FOREST INFLUENCE ON THE SURFACE WATER CHEMISTRY OF GRANITIC BASINS RECEIVING ACID PRECIPITATION IN THE VOSGES MASSIF, FRANCE.**
Strasbourg-1 Univ. (France). Inst. de Geologie.
For primary bibliographic entry see Field 5B.
W90-01442

**FROM THE PLOT TO THE WATERSHED: SCALE EFFECT IN THE AMAZONIAN FOREST ECOSYSTEM (DE LA PARCELLE AU PETIT BASSIN-VERSANT: EFFET D'ECHELLE DANS L'ECOSYSTEME FORESTIER AMAZONIEN).**
Office de la Recherche Scientifique et Technique Outre-Mer, Cayenne (French Guiana).
For primary bibliographic entry see Field 4D.
W90-01444

**INFILTRATION AND REDISTRIBUTION OF OVERLAND FLOW AND SEDIMENT ON A LOW RELIEF LANDSCAPE OF SEMI-ARID, TROPICAL QUEENSLAND.**
James Cook Univ. of North Queensland, Townsville (Australia). Dept. of Geography.
M. Bonell, and J. Williams.
IN: Forest Hydrology and Watershed Management. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication No. 167, 1987. p 199-211, 2 fig, 2 tab, 27 ref.

Descriptors: *Soil erosion, *Erosion, *Eucalyptus tree, *Australia, *Sediment transport, *Forest hydrology, *Overland flow, *Slope degradation, Tropical regions.

The processes of overland flow and sediment transfer under natural rainfall are described for a sloping area of open eucalypt woodland in Queensland. The spatial heterogeneity of surface soil hydraulic properties causes some sections of the slope to export runoff and sediment while other sections accept water and sediment as runon and sediment, allowing a continuous relationship between deposition and runon to erosion and runoff to be established. The net loss from the slope under the present land use is small and from the event sequence studied for two yrs was not significantly altered by fire, although sediment movement was increased following fire. (See also W90-01432) (Author's abstract)
W90-01451

**PRELIMINARY ASSESSMENT OF SOIL HYDRAULIC PROPERTIES, AND THEIR IMPLICATIONS FOR AGRO FORESTRY MANAGEMENT IN GRENADA, WEST INDIES.**
Plymouth Polytechnic (England). Dept. of Geographical Sciences.
For primary bibliographic entry see Field 2G.
W90-01470

**STREAMFLOW CHARACTERISTICS OF TWO SMALL, STEEP AND FORESTED WATERSHEDS IN HIGH ELEVATION AREAS OF CENTRAL TAIWAN.**
British Columbia Ministry of Forests, Kamloops. Hydrology Research Section.
J. D. Cheng, Y. J. Hsia, H. S. Lu, V. C. Liu, and C. C. Koh.
IN: Forest Hydrology and Watershed Management. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication No. 167, 1987. p 499-508, 4 fig, 4 tab, 9 ref.

Descriptors: *Rainfall-runoff relationships, *Forest hydrology, *Watersheds, *Storm runoff, *Taiwan, Streamflow, Vegetation effects, Rainfall, Slopes, Typhoons.

Streamflow quantities and regimes of the study watersheds, PL-11 and PL-12, reflect the strong influences of abundant and intense torrential rainfalls during the May to October typhoon season. Streamflow is highly correlated with rainfall. The PL-12 watershed generally produces higher streamflows from similar rainfall inputs than the PL-11 watershed probably due to lower evapotranspiration losses and higher contributions from subsurface water storage. The two watersheds are closely correlated for all streamflow parameters analyzed. Despite having shallow soils and steep slopes, the study watersheds' streamflow regulation capacities are large, possibly due in part, to each having good vegetation cover. (See also W90-01432) (Author's abstract)
W90-01478

**CHANGES IN STREAMFLOW PEAKS FOLLOWING TIMBER HARVEST OF A COASTAL BRITISH COLUMBIA WATERSHED.**
British Columbia Univ., Vancouver. Faculty of Forestry.
For primary bibliographic entry see Field 4C.
W90-01479

**RUNOFF FORMATION CONCEPT TO MODEL WATER PATHWAYS IN FORESTED BASINS.**
Technische Univ. Braunschweig (Germany, F.R.). Inst. fuer Geographie.
A. Herrmann, J. Koll, M. Schoniger, and W. Stichler.
IN: Forest Hydrology and Watershed Management. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication No. 167, 1987. p 519-529, 4 fig, 31 ref.

Descriptors: *Rainfall-runoff relationships, *Forest hydrology, *Runoff, *Surface flow, *Hydrologic models, Groundwater runoff, Aquifers, Porosity, Hydrographs, Mapping.

Starting from common model concepts, ideas are being developed concerning runoff formation by using the Lange Bramke basin/Harz Mts. (0.76 sq km, 543-700 m a.m.s.l., 90% forested) as an example. These are mainly based on the experimental results from isotopical hydrograph separation, sprinkling, and groundwater table monitoring. From the evidence of spontaneous hydraulic response of fractured rock and porous aquifers causing important exfiltration to streams, and of efficient macropore systems in the unsaturated soil zone which guarantee rapid compensation of groundwater losses, it is concluded that the old concept of surface flow primarily generating flood hydrographs must be revised. Future tasks concern regional diversification of experiments, mapping of variable subsurface source areas (aquifers), and numerical model treatment of relevant hydrologic and hydraulic parameters. (See also W90-01432) (Author's abstract)
W90-01480

**CARNATION CREEK, CANADA--REVIEW OF A WEST COAST FISH/FORESTRY WATERSHED IMPACT PROJECT.**
Pacific Forestry Centre, Victoria (British Columbia).
For primary bibliographic entry see Field 5B.
W90-01481

**SOURCE OF INCREASED STORMWATERS AFTER FOREST OPERATIONS.**
Virginia Polytechnic Inst. and State Univ., Blacksburg. School of Forestry.
For primary bibliographic entry see Field 4C.
W90-01482

**EFFECT OF CLEARCUTTING ON STREAMFLOW GENERATING PROCESSES FROM A SUBALPINE FOREST SLOPE.**
Forest Service, Fort Collins, CO.
For primary bibliographic entry see Field 4C.
W90-01483

**EFFECT OF ASPEN HARVEST AND GROWTH ON WATER YIELD IN MINNESOTA.**
North Central Forest Experiment Station, Grand Rapids, MN. Forestry Sciences Lab.
E. S. Verry.
IN: Forest Hydrology and Watershed Management. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication No. 167, 1987. p 553-562, 4 fig, 3 tab, 11 ref.

Descriptors: *Clear-cutting, *Forest hydrology, *Rainfall-runoff relationships, *Water yield, *Forest watersheds, *Snowmelt, *Streamflow, Precipitation, Biomass, Aspen, Seasonal variation, Regrowth.

Annual water yield increased following the clearcutting of a mature aspen forest in yrs 1-9 and yr 14 of subsequent aspen regrowth. Maximum increases of 85, 117, and 88 mm/yr occurred during the first 3 yrs of regrowth. Increases in streamflow volumes from snowmelt and early spring rains were minimal and more variable after harvest and regeneration. Most of the increases occurred during the leaf-on periods, but sporadic increases occurred during the fall-early winter recharge period as long as 15 yrs after harvest. Increases in water yield were best explained by changes in aboveground biomass, but precipitation, especially during the leaf-on periods, improved the relation. Increases in annual water yields became insignificant when aboveground biomass approached 57 t/ha (17% of mature forest biomass at 14-15 yrs of age). (See also W90-01432) (Author's abstract)
W90-01484

**EFFECTS OF WHOLE-TREE CLEARCUTTING ON STREAMFLOW CAN BE ADEQUATELY ESTIMATED BY SIMULATION.**
Northeastern Forest Experiment Station, Durham, NH. Forestry Sciences Lab.
J. W. Hornbeck, C. A. Federer, and R. S. Pierce.
IN: Forest Hydrology and Watershed Management. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication No. 167, 1987. p 565-573, 1 fig, 4 tab, 9 ref.

Descriptors: *Model studies, *Simulation analysis, *Rainfall-runoff relationships, *Forest hydrology, *Hydrologic models, *Clear-cutting, *Forest watersheds, *Streamflow, Regrowth, Nutrients, BROOK model, Maine, Connecticut, New Hampshire.

A range of values was assigned to parameters of the BROOK hydrologic model to simulate streamflow for fast, medium, and slow regrowth on whole-tree clearcut basins in Main, New Hampshire, and Connecticut. Simulated increases in streamflow for the first yr after harvest at the New Hampshire site ranged from 167 mm for fast regrowth to 255 mm for slow regrowth. The measured increase estimated using paired control and treatment basins was 175 mm. Simulated increases in the second yr ranged from 74 to 234 mm, while the paired basin estimate was 71 mm. Annual outputs of dissolved nutrients showed only small differences when calculated with simulated versus measured streamflow. At the Maine and Connecticut sites where streamflow was not measured, simulated annual streamflow increases differed little from New Hampshire, but seasonal increases and relative increases varied considerably. The BROOK model is a viable alternative for estimating streamflow when stream-gauging is impractical. (See also W90-01432) (Author's abstract)
W90-01485

**SIMULATION OF EFFECTS OF FOREST GROWTH ON WATER YIELD WITH A DYNAMIC PROCESS-BASED USER MODEL.**
Natal Univ., Pietermaritzburg (South Africa). Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 4C.
W90-01486

**ANALYSIS OF STORMFLOW AND ITS SOURCE AREA EXPANSION THROUGH A SIMPLE KINEMATIC WAVE EQUATION.**
Forest and Forest Products Research Inst., Kyoto (Japan). Kansai Branch.
For primary bibliographic entry see Field 2A.
W90-01489

**RUNOFF VARIABILITY: A GLOBAL PERSPECTIVE.**
Melbourne Univ., Parkville (Australia). Dept. of Civil Engineering.
T. A. McMahon, B. L. Finlayson, A. Haines, and R. Srikanthan.
IN: The Influence of Climate Change and Climatic Variability on the Hydrologic Regime and Water Resources, International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication No. 168, 1987. p 3-11, 7 fig, 3 tab, 13 ref.

Descriptors: *Runoff variability, *Climatology, *Hydrologic data collections, *Precipitation, Annual runoff, Flood peak, Effective precipitation.

A data base consisting of monthly and annual flows, peak annual instantaneous flows and monthly precipitation has been assembled from around the world to allow analysis of streamflow characteristics at the continental scale. At the annual level, the major intercontinental differences are in terms of variability. Australia and Southern Africa are distinguished from the rest of the world by their high variability and the observed differences persist even when the comparisons are made between areas of like climatic characteristics and the same latitudes. For any given precipitation variability, the runoff variability in Australia and Southern Africa is much higher than for the rest of the world. Analysis using a single linear storage model suggests that it is the higher variability of effective precipitation in Australia and Southern Africa, which results from high evaporative demand there, which is one of the major causes of the observed differences in runoff variability. (See also W90-01537) (Author's abstract)
W90-01538

**VARIATION OF RIVER DISCHARGES AND LAKE LEVELS IN WEST AFRICA SINCE THE BEGINNING OF THE TWENTIETH CENTURY, (VARIATION DES DEBITS DES COURS D'EAU ET DES NIVEAUX DES LACS EN AFRIQUE DE L'OUEST DEPUIS LE DEBUT DU 20EME SIECLE).**
Comite National Francais des Sciences Hydrologiques, Paris (France).
J. H. A. Sircoulon.
IN: The Influence of Climate Change and Climatic Variability on the Hydrologic Regime and Water Resources, International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication No. 168, 1987. p 13-25, 5 fig, 4 tab, 18 ref.

Descriptors: *Climatology, *Runoff variability, *Stream discharge, *Lakes, *Africa, Water level fluctuations, Temporal distribution, Climates.

Great interannual fluctuations of water surface resources of large river basins in West Africa are experienced due to climatic variations. Difficulty in appraising the resources is experienced because only sparse time series are recorded since the beginning of the 20th century. Decreased runoff contributing to the tropical rivers is suggested since the end of the last century, and particularly during the last 20 yrs. The water yields to the Sahelian zone have fallen 40% resulting in very low lake levels, and in some cases lakes have disappeared entirely. (See also W90-01537) (Author's abstract)
W90-01539

**ANALYSIS OF THE VARIATION TREND OF THE ANNUAL RUNOFF ON THE NORTHERN SLOPE OF QILIAN SHAN.**
Academia Sinica, Lanzhou (China). Lanzhou Inst. of Glaciology and Cryopedology.
Z. Lai.
IN: The Influence of Climate Change and Climatic Variability on the Hydrologic Regime and Water Resources, International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication No. 168, 1987. p 27-36, 3 fig, 5 tab, 5 ref.

Descriptors: *Runoff variability, *Annual runoff, *China, *Climatology, Precipitation, Runoff forecasting.

The relationship between climatic change and runoff variation of the streams in this region is analyzed in conjunction with information on the atmospheric circulation and the yr-to-yr change of temperature and precipitation both inside and outside this mountainous area. The analysis shows that the occurrence of a yr with low water in the eastern section of the mountains is usually related to a strengthening of the zonal circulation in high-mid latitudes in Eurasia; the influence of convective precipitation in the mountain area on the variation of annual runoff cannot be ignored. The variation of the annual runoff is simulated using time series analysis. A forecast for the next 5 to 10 yrs is made based on the models as well as changes in the circulation and climate. (See also W90-01537) (Author's abstract)
W90-01540

**EVALUATION OF RUNOFF CHANGES IN THE LABE RIVER BASIN BY SIMULATING THE PRECIPITATION-RUNOFF PROCESS.**
Ceskoslovenska Akademie Ved, Prague. Hydrometeorological Inst.
J. Buchtele, and M. Zemlicka.
IN: The Influence of Climate Change and Climatic Variability on the Hydrologic Regime and Water Resources, International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication No. 168, 1987. p 63-75, 9 fig, 1 tab, 3 ref.

Descriptors: *Climatology, *Runoff variability, *River basins, *Czechoslovakia, Simulation analysis, Time series analysis, Rainfall-runoff relationships.

The rainfall-runoff simulations based on a daily time interval have been carried out for the Czech part of the Labe River basin in Czechoslovakia (area approx. 52,000 sq km) for the periods from 1895 to 1933 and from 1939 to 1953. The deterministic Tank model has been used for this purpose. The goal was to evaluate the changes for the longest possible span of time--but outside the interval in which the reservoirs could have a marked effect. Before deterministic modelling, statistical time series analysis had been made. Several time intervals were used (delta 5 = 1 da, 1 mo, 3 mos, 1 yr). The results indicate that the most problematic input is evaporation. The analysis also seems to offer some results from which some changes in runoff are apparent: cross-correlation between daily precipitation and runoff were investigated for ea summer half-yr separately. A distinctly sharper form of this function in that period seems to be an indication of the basins's faster response. Variations of the simulated runoff due to the changes in some inputs (precipitation, air temperature, snow conditions) were also investigated, and some comparisons are given that illustrate the responses of basins with different areas. (See also W90-01537) (Author's abstract)
W90-01543

**CLIMATIC FLUCTUATIONS AND RUNOFF FROM GLACIERISED ALPINE BASINS.**
Manchester Univ. (England). Dept. of Geography.
D. N. Collins.
IN: The Influence of Climate Change and Climatic Variability on the Hydrologic Regime and Water Resources, International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication No. 168, 1987. p 77-89, 3 fig, 7 tab, 10 ref.

Descriptors: *Glaciohydrology, *Runoff variability, *Climatology, *Glaciation, *Alpine regions, Temperature, Regression analysis, Switzerland.

Records of discharge from gauges on rivers draining from glaciated basins in the Swiss Alps for the period 1922-1983 were analyzed together with climatic data in order to describe climatic variation and to determine the impact on total annual flows. Mean May-September air temperature and annual discharge show considerable yet markedly parallel year-to-year variations at all stations. Generally warmer summers in the late 1920s, mid-1930s, 1940s and late 1950s are reflected in higher discharges with a maximum in 1947. Cooler temperatures and reduced flows characterized the 1960s and 1970s before slight recovery in the 1980s. A fall in 10-year mean temperature of 1 deg C produced a reduction of about 25% in 10-year mean discharge. Five-year running means of annual totals of precipitation increased from the 1940s to the 1970s. Glacier area reduced between the 1920s and 1950s before stabilizing. High levels of explanation of variance of discharge were obtained using multiple regression on mean ablation season air temperature and winter precipitation accumulation, the degree of fit being greater for basins with larger % glaciation. (See also W90-01537) (Author's abstract)
W90-01544

**PALEOFLOOD HYDROLOGY AND HYDROCLIMATIC CHANGE.**
Arizona Univ., Tucson. Dept. of Geosciences.
For primary bibliographic entry see Field 2A.
W90-01548

**SPACE-TIME MODELLING OF RAINFALL-RUNOFF PROCESS.**
Ottawa Univ. (Ontario). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2B.
W90-01561

**FOURIER-ARIMA MODELLING OF THE MULTIANNUAL FLOW VARIATION.**
Cluj-Napoca Univ. (Romania). Dept. of Geography.
I. Haidu, P. Serbrn, and M. Simota.
IN: The Influence of Climate Change and Climatic Variability on the Hydrologic Regime and Water Resources, International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication No. 168, 1987. p 281-286, 2 fig, 1 tab, 3 ref.

Descriptors: *Streamflow variability, *Model studies, *Fourier analysis, *Regression analysis, Flow pattern, Flow forecasting, Statistical methods.

In order to analyze multiannual flow variations, Fourier, ARIMA (autoregressive, moving average) and combined Fourier-ARIMA models were used. The combined Fourier-ARIMA model takes into account the following components: the general trends, the periodical component, the moving average and the random component. Eleven chronological series of annual mean discharges extending over periods of 55-145 yrs, were analyzed by means of the models. Relative error analysis of the mean annual computed hydrograph and the mean annual measured hydrograph emphasized the superiority of the combined Fourier-ARIMA model over the Fourier and ARIMA models. This combined model provides for a substantially more accurate elaboration of a flow prognosis for groups of yrs with different qualitative hydrologic characteristics. (See also W90-01537) (Author's abstract)
W90-01562

**BAYESIAN FORECASTING OF HYDROLOGIC VARIABLES UNDER CHANGING CLIMATOLOGY.**
Arizona Univ., Tucson. Dept. of Systems and Industrial Engineering.
For primary bibliographic entry see Field 7B.
W90-01564

**IMPACT OF CLIMATE CHANGE ON THE MORPHOLOGY OF RIVER BASINS.**
F. H. Verhoog.
IN: The Influence of Climate Change and Climatic Variability on the Hydrologic Regime and Water Resources, International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication No. 168, 1987. p 315-326, 5 tab, 9 ref.

Descriptors: *Geomorphology, *Climates, *River basins, *Greenhouse effect, *Global warming, Precipitation, Evapotranspiration, Runoff, Morphology, Ecology.

A review of the impact of climate on river basin morphology is presented in the form of tables and general discussion. Topics covered include: (1) impacts of global warming on precipitation and evapotranspiration; (2) runoff impacts; (3) ecological changes; (4) impacts of ecological change on hydrology; and (4) impacts on river morphology. It is predicted that the warming up of the earth due to CO2 doubling and the increase in concentration of other man-made gases, will come about gradually and the impacts will also become visible gradually. (See also W90-01537) (Author's abstract)
W90-01565

**IMPACTS OF ALTERNATING FLOOD AND DROUGHT-DOMINATED REGIMES ON CHANNEL MORPHOLOGY AT PENRITH, NEW SOUTH WALES, AUSTRALIA.**
Sydney Univ. (Australia).
R. F. Warner.
IN: The Influence of Climate Change and Climatic Variability on the Hydrologic Regime and Water Resources, International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication No. 168, 1987. p 327-338, 1 fig, 9 tab, 27 ref.

Descriptors: *Geomorphology, *Climatology, *Channel morphology, *Australia, *Flood channels, *Drought, Flood routing, Magnitude, Frequency, Water depth, Width.

Long flood records for the Hawkesbury-Nepean River have been used to define alternating flood- (FDRs) and drought-dominated regimes (DDRs). In the former, flood magnitudes and frequencies are higher with mean annual flood discharges (Q2.33) from 2 to 4 times for the latter. If channel size is assumed to be related to some level(s) of discharge, then such regime variations create the potential for channel change or adjustments. Surveys since 1863 at Penrith provide some insight into adjustments related to regime changes. In FDRs channel widths generally increase and depths decrease, while in DDRs, these changes are reversed. Human impacts in and beyond the channel modify the nature of adjustment or response. (See also W90-01537) (Author's abstract)
W90-01566

**DROUGHT, RUNOFF AND SURFACE WATER RESOURCES--EFFECTS ON SMALL WATERSHEDS IN BURKINA FASO (SECHERESSE, DESERTIFICATION ET RESSOURCES EN EAU DE SURFACE--APPLICATION AUX PETITS BASSINS DU BURKINA FASO).**
Office de la Recherche Scientifique et Technique Outre-Mer, Montpellier (France). Lab. d'Hydrologie.
For primary bibliographic entry see Field 2B.
W90-01568

**IMPACTS OF CO2-INDUCED CLIMATE CHANGE ON HYDRO-ELECTRIC GENERATION POTENTIAL IN THE JAMES BAY TERRITORY OF QUEBEC.**
Montreal Univ. (Quebec).
For primary bibliographic entry see Field 4C.
W90-01572

**CLIMATE CHANGE AND WATER RESOURCES.**
World Meteorological Organization, Geneva (Switzerland).
For primary bibliographic entry see Field 4C.
W90-01573

**SPATIAL AND TEMPORAL VARIABILITY OF THE WATER BALANCE OF SOME WATERSHEDS IN WESTERN AFRICA IN RELATION TO CLIMATIC CHANGES (VARIABILITE SPATIALE ET TEMPORELLE DES BILANS HYDIPUES DE QUELQUES BASSINS VERSANTS D'AFRIQUE DEL'OUEST EN LIAISON AVEC LES CHENGEMENTS CLIMATIQUES).**
Office de la Recherche Scientifique et Technique Outre-Mer, Montpellier (France). Lab. d'Hydrologie.
For primary bibliographic entry see Field 2A.
W90-01575

**PERSISTENT CONSEQUENCES OF THE PRESENT DROUGHT ON THE FLOWS OF THE SENEGAL RIVER AND THE HYPERSALINISATION OF THE LOWER CASAMANCE (LES CONSEQUENCES DURABLES DE LA SECHERESSE ACTUELLE SUR L'ECULEMENT DU FLEUVE SENEGAL ET L'HYPERSALINISATION DE LA BASSE-CASAMANCE).**
Office de la Recherche Scientifique et Technique Outre-Mer, Paris (France).
For primary bibliographic entry see Field 2B.
W90-01579

**INTERFLOW.**
Lancaster Univ. (England). Centre for Research on Environmental Systems.
For primary bibliographic entry see Field 2A.
W90-01597

**INFLUENCE OF THE METHOD FOR EFFECTIVE RAIN DETERMINATION ON THE PARAMETERS OF NASH MODEL FOR URBANIZED WATERSHED.**
Agricultural Univ. of Warsaw (Poland).
For primary bibliographic entry see Field 2B.
W90-01613

**USE OF REGRESSION TECHNIQUES TO ESTIMATE OVERFLOW FREQUENCIES FROM DAILY PRECIPITATION DATA.**
Royal Netherlands Meteorological Inst., De Bilt.
For primary bibliographic entry see Field 5D.
W90-01617

**INTERACTION OF FLOOD WATER FLOWS IN SEWER NETWORKS AND SMALL RIVER SYSTEMS.**
Ingenieurbuero fuer Conrath und Partner, Spiesen-Elversberg (Germany, F.R.).
For primary bibliographic entry see Field 2A.
W90-01625

**REDUCTION MEASURES FOR FLOOD RUNOFF AND THE ESTIMATION OF THE EFFECTIVE RAINFALL OF THE SMALL RIVERS IN TOKYO METROPOLIS.**
Institute of Civil Engineering, Tokyo (Japan).
For primary bibliographic entry see Field 2A.
W90-01644

**PHOSPHORUS CONTENT OF STORMWATER RUNOFF.**
Karlsruhe Univ. (Germany, F.R.). Inst. fuer Siedlungswasserwirtschaft.
For primary bibliographic entry see Field 5B.
W90-01655

**AGGRAVATION OF FLOOD CONDITIONS DUE TO INCREASED INDUSTRIALIZATION AND URBANIZATION.**
Eidgenoessische Technische Hochschule, Zurich (Switzerland).
For primary bibliographic entry see Field 4C.
W90-01668

**RUNNING WATERS IN URBANIZED AREAS.**
Landesamt fuer Wasser und Abfall Nordrhein-Westfalen, Duesseldorf (Germany, F.R.).
For primary bibliographic entry see Field 4C.
W90-01684

**BROOKS INSIDE THE CITY, EXAMPLE: CITY OF ZURICH.**
For primary bibliographic entry see Field 4C.
W90-01686

**RE-NATURATION OF WATERCOURSES IN THE NORTH RHINE-WESTPHALIAN INDUSTRIAL REGION.**
Emschergenossenschaft und Lippeverband, Essen (Germany, F.R.).
For primary bibliographic entry see Field 5G.
W90-01688

**CHEMICAL CHARACTERISTICS OF STREAMS IN THE MID-ATLANTIC AND SOUTHEASTERN UNITED STATES (NATIONAL STREAM SURVEY-PHASE I). VOLUME I: POPULATION DESCRIPTIONS AND PHYSICO-CHEMICAL RELATIONSHIPS.**
Environmental Protection Agency, Washington, DC. Office of Acid Deposition, Environmental Monitoring, and Quality Assurance.
For primary bibliographic entry see Field 5B.
W90-01727

**ADVANCES IN HYDROMETRY.**
International Association of Hydrological Sciences.
For primary bibliographic entry see Field 7B.
W90-01795

**HYDROMETRIC CABLEWAYS IN THE YANGTZE VALLEY.**
Yangtze Valley Planning Office, Wuhan (China). Hydrology Dept.
For primary bibliographic entry see Field 7B.
W90-01796

**FLOW MEASUREMENTS IN OPEN AND CLOSED CONDUITS OF GRAVITATIONAL URBAN STORM SEWER NETWORKS.**
Vizgazdalkodasi Tudomanyos Kutato Intezet, Budapest (Hungary).
For primary bibliographic entry see Field 7B.
W90-01797

**CURRENT METER CALIBRATION: INDIVIDUAL RATING VERSUS GROUP RATING.**
Department of the Environment, Reading (England). Water Data Unit.
For primary bibliographic entry see Field 7B.
W90-01798

**UP-DATING OF DISCHARGE RATING CURVES BY MEANS OF MATHEMATICAL MODELS.**
Institut fuer Wasserwirtschaft, Berlin (German D.R.).
For primary bibliographic entry see Field 7B.
W90-01799

**METHOD OF UNIFORMIZING THE STAGE-DISCHARGE RELATIONS OF STABLE RIVER BEDS AND ITS APPLICATION.**
Yangtze Valley Planning Office, Wuhan (China). Hydrology Dept.
For primary bibliographic entry see Field 7B.
W90-01800

**EQUATIONS FOR ESTIMATING DISCHARGE IN STEEP CHANNELS WITH COARSE BED MATERIAL.**
Institute of Hydrology, Wallingford (England).
For primary bibliographic entry see Field 7B.
W90-01801

**MULTILAYER WIDTH-INTEGRATED VELOCITY MEASUREMENT METHOD.**
Fujian Provincial Hydrometric Station, Fuzhou (China).
For primary bibliographic entry see Field 7B.
W90-01802

**MOVING BOAT DISCHARGE MEASUREMENTS USING ACOUSTIC DOPPLER TECHNIQUES.**
Geological Survey, NSTL Station, MS. Gulf Coast Hydroscience Center.
For primary bibliographic entry see Field 7B.
W90-01803

**DEVELOPMENTS IN HYDROMETRY IN INDIA.**
Central Water Commission, New Delhi (India).
For primary bibliographic entry see Field 7B.
W90-01804

**DESIGN AND STUDY OF THE INSTRUMENTATION REQUIRED FOR THE MEASUREMENT OF DISCHARGE BY THE MOVING BOAT METHOD.**
Water Conservancy Hydroelectric Power Scientific Research Inst., Beijing (China).
For primary bibliographic entry see Field 7B.
W90-01805

**SAHELIAN HYDROMETRY: CURRENT TECHNIQUE AND PERSPECTIVES OF DEVELOPMENT (L'HYDROMETRIE AU SAHEL: TECHNIQUE ACTUELLE ET PERSPECTIVES DE DEVELOPPEMENT).**
Agrhymet Centre, Niamey (Niger).
For primary bibliographic entry see Field 7B.
W90-01806

**FLOOD FLOW GAUGING WITH TRITIUM IN SOUTHERN AFRICA.**
Ministry of Water Development, Salisbury (Zimbabwe). Hydrological Branch.
For primary bibliographic entry see Field 7B.
W90-01807

**TRACER MEASUREMENTS IN LOWLAND RIVERS.**
Vrije Univ., Brussels (Belgium). Lab. of Hydrology.
For primary bibliographic entry see Field 7B.
W90-01808

**TWO LESS CONVENTIONAL METHODS OF FLOW-GAUGING.**
Leicester Univ. (England). Dept. of Engineering.
For primary bibliographic entry see Field 7B.
W90-01809

**RISING AIR FLOAT TECHNIQUE FOR THE MEASUREMENT OF STREAM DISCHARGE.**
Lancaster Univ. (England). Dept. of Environmental Sciences.
For primary bibliographic entry see Field 7B.
W90-01810

**INSTALLATION AND OPERATION OF A BUBBLE GAUGE NETWORK IN THE MAHAKAM RIVER BASIN, EAST KALIMANTAN, INDONESIA.**
German Agency for Technical Cooperation, Frankfurt am Main (Germany, F.R.).
For primary bibliographic entry see Field 7B.
W90-01811

**IMPROVEMENT OF ULTRASONIC FLOWMETER IN RIVERS IN JAPAN.**
National Research Center for Disaster Prevention, Sakura (Japan).
For primary bibliographic entry see Field 7B.
W90-01813

**MEASUREMENT OF OPEN CHANNEL FLOW BY THE ELECTROMAGNETIC GAUGE.**
Department of the Environment, Reading (England). Water Data Unit.
For primary bibliographic entry see Field 7B.
W90-01815

**MONITORING WATER QUANTITY AND WATER QUALITY IN AN URBAN BASIN.**
Rijksdienst voor de Ijsselmeerpolders, Lelystad (Netherlands).
For primary bibliographic entry see Field 7B.
W90-01818

**HADDINGTON FLOOD WARNING SYSTEM.**
Institute of Hydrology, Wallingford (England).
For primary bibliographic entry see Field 7B.
W90-01819

**SATELLITE DATA AS A BASIS FOR THE ESTIMATION OF RAINFALL AND RUNOFF.**
Ruhr Univ., Bochum (Germany, F.R.).
For primary bibliographic entry see Field 7B.
W90-01820

**DETERMINATION OF A MEASURING NETWORK ALONG RIVERS.**
Technische Hogeschool Delft (Netherlands). Dept. of Civil Engineering.
For primary bibliographic entry see Field 7B.
W90-01823

**SPECIFIC HYDROMETRY OF KARST REGIONS.**
Split Univ. (Yugoslavia). Faculty of Civil Engineering Sciences.
For primary bibliographic entry see Field 7B.
W90-01824

**DEVELOPMENTS IN HYDROMETRY IN CENTRAL AMERICA AND BRAZIL.**
Projecto de Hidrologia e Climatologia da Amazonia, Belem (Brazil).
For primary bibliographic entry see Field 7B.
W90-01825

**AUTOMATION OF DAILY WATER DISCHARGE COMPUTATION FOR RIVERS WITH DIFFERENT REGIMES.**
Sredneaziatskii Nauchno-Issledovatel'skii Gidrometeorologicheskii Inst., Tashkent (USSR).
For primary bibliographic entry see Field 7B.
W90-01826

**ADVANCED HYDROLOGIC INSTRUMENTATION ACTIVITIES WITHIN THE WATER RESOURCES DIVISION OF THE US GEOLOGICAL SURVEY.**
Geological Survey, Reston, VA. Water Resources Div.
For primary bibliographic entry see Field 7B.
W90-01827

**LARGE SCALE EFFECTS OF SEASONAL SNOW COVER AND TEMPERATURE INCREASE ON RUNOFF.**
Agricultural Research Service, Beltsville, MD. Hydrology Lab.
For primary bibliographic entry see Field 2C.
W90-01861

**SNOWMELT-RUNOFF SIMULATION MODEL OF A CENTRAL CHILE ANDEAN BASIN WITH RELEVANT OROGRAPHIC EFFECTS.**
Direccion General de Aguas, Santiago (Chile).
For primary bibliographic entry see Field 2C.
W90-01865

**UTILITY OF COMPUTER-PROCESSED NOAA IMAGERY FOR SNOW COVER MAPPING AND STREAMFLOW SIMULATION IN ALBERTA.**
Alberta Environment, Edmonton.
For primary bibliographic entry see Field 2C.
W90-01866

**SNOW COVER AREA (SCA) IS THE MAIN FACTOR IN FORECASTING SNOWMELT RUNOFF FROM MAJOR RIVER BASINS.**
National Remote Sensing Agency, Hyderabad (India). Hydrology Div.
For primary bibliographic entry see Field 2C.
W90-01867

**MODELLING OF SNOWMELT DISTRIBUTION FOR THE ESTIMATION OF BASIN-WIDE SNOWMELT USING SNOW COVERED AREA.**
Tokyo Univ. (Japan). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2C.
W90-01868

**DETERMINATION OF WATER EQUIVALENT OF SNOW AND THE FORECAST OF SNOWMELT RUNOFF BY MEANS OF ISOTOPES IN TURKEY.**
State Hydraulic Works, Ankara (Turkey). Technical Research and Quality Control Dept.
For primary bibliographic entry see Field 2C.
W90-01870

**INFLUENCE OF THE VARIABILITY OF SNOW COVER THICKNESS ON THE INTENSITY OF WATER YIELD AND DURATION OF SPRING FLOOD ON A SMALL RIVER.**
Gosudarstvennyi Gidrologicheskii Inst., Leningrad (USSR).
For primary bibliographic entry see Field 2C.
W90-01872

## 2F. Groundwater

**MANAGING GROUND WATER QUALITY IN RELATION TO AGRICULTURAL ACTIVITIES.**
Maryland Univ., College Park. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 5G.
W90-00975

**EFFECT OF SULFOMETURON METHYL ON GROUND WATER AND STREAM QUALITY IN COASTAL PLAIN FOREST WATERSHEDS.**
Southeastern Forest Experiment Station, Gainesville, FL.
For primary bibliographic entry see Field 5B.
W90-00977

**DRASTIC APPROACH TO CONTROLLING GROUNDWATER POLLUTION.**
For primary bibliographic entry see Field 5G.
W90-01009

**EFFECTS OF PARAMETER UNCERTAINTY ON PREDICTIONS OF UNSATURATED FLOW.**
Virginia Polytechnic Inst. and State Univ., Blacksburg. Center for Environmental and Hazardous Material Studies.
For primary bibliographic entry see Field 2G.
W90-01018

**RIVER-GROUNDWATER RELATIONSHIPS IN THE LOWER PARTS OF THE NETHERLANDS.**
Rijksinstituut voor de Volksgezondheid en Milieuhygiene, Bilthoven (Netherlands).
For primary bibliographic entry see Field 2A.
W90-01019

**HYDROGEOLOGY AND HYDROCHEMISTRY OF CRETACEOUS AQUIFERS, SOUTHERN HIGH PLAINS, U.S.A.**
Texas Univ. at Austin. Bureau of Economic Geology.
R. Nativ, and G. N. Gutierrez.
Journal of Hydrology JHYDA7, Vol. 108, No. 1-4, p 79-109, Jun 1989. 11 fig, 2 tab, 53 ref, 2 append.

Descriptors: *High Plains Aquifer, *Geohydrology, *Aquifers, *Groundwater recharge, Sandstones, Limestone, Shales, Sand dunes, Southern High Plains.

Cretaceous rocks in the Southern High Plains, traditionally considered to be part of the High Plains aquifer and to be recharged by the overlying Ogallala aquifer, actually contain three aquifers with different recharge sources. Two separate subcrop areas of Cretaceous rocks underlie the Ogallala Formation. These subcrops are composed of sandstones, limestones, and shales having a total thickness of as much as 76 m. Three aquifers, the

Trinity sandstone, the Edwards limestone, and the Duck Creek-Kiamichi sandstones and limestones, were identified within the Cretaceous section. Wherever the Ogallala aquifer is thin or missing, Cretaceous aquifers are the main water supply. Major recharge sources are (1) percolation through thick surficial alluvial deposits and sand dunes in New Mexico and northwestern Texas, and (2) leakage from the underlying Dockum aquifer in eastern New Mexico. Recharge from the overlying Ogallala aquifer is restricted to small parts of the study area. Elsewhere, differences in hydraulic heads and similarities in chemical and isotopic composition suggest cross-formational flow from Cretaceous aquifers into the overlying Ogallala Formation or into the underlying Dockum Group. (Author's abstract)
W90-01021

**METHOD FOR CONSERVING CORE-STORAGE AND COMPUTING TIME IN AQUIFER SIMULATION MODELS.**
Zimbabwe Univ., Harare. Dept. of Geology.
For primary bibliographic entry see Field 7C.
W90-01022

**HYDROCHEMICAL EVOLUTION OF REGIONAL GROUNDWATERS TO PLAYA BRINES IN CENTRAL AUSTRALIA.**
Bureau of Mineral Resources, Geology and Geophysics, Canberra (Australia).
For primary bibliographic entry see Field 2H.
W90-01023

**HYDRODYNAMIC DISPERSION IN KARSTIFIED LIMESTONES AND DOLOMITES IN THE UPPER JURASSIC OF THE FRANCONIAN ALB, F.R.G.**
Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.). Inst. fuer Hydrologie.
K.-P. Seiler, P. Maloszewski, and H. Behrens.
Journal of Hydrology JHYDA7, Vol. 108, No. 1-4, p 235-247, Jun 1989. 9 fig, 1 tab, 16 ref.

Descriptors: *Karst hydrology, *Aquifers, *Limestone, *Dolomite, *West Germany, *Groundwater movement, *Hydrodynamics, *Dispersion, *Geologic fractures, Mathematical models, Tracers, Franconian Alb.

In the Upper Jurassic carbonates of the southern Franconian Alb, groundwater flow is much more pronounced in fissures than in solution channels. With increasing thickness of the aquifer, and with the predominance of dolomitic reef facies, tracer dilution becomes stronger. The evaluation of dispersion in the study area was based on the one-dimensional approximation of tracer transport in the fissured aquifer and considers diffusive tracer exchange between mobile and quasi-stagnant water. The dispersion parameter was found in each tracer experiment by applying the fitting procedure with the Single Fissure Dispersion Model. In solution channels, dispersion seems not to depend significantly upon flow distance. In fissures, however, dispersivities increase comparatively strongly with flow distance. Calculated dispersivities range from 4 m in solution channels to 10 m in fissures. All dispersivities are related to recovery rate, which can be judged as a measure of the draining influence of flow in solution channels on fissure flow. Dispersivities in fissures are lower than in comparable porous media. (Author's abstract)
W90-01027

**PALEOHYDROLOGY AFFECTING RECHARGE TO OVEREXPLOITED SEMICONFINED AQUIFERS IN THE MEHSANA AREA, GUJARAT STATE, INDIA.**
E. Bradley, and P. N. Phadtare.
Journal of Hydrology JHYDA7, Vol. 108, No. 1-4, p 309-322, Jun 1989. 2 fig, 2 tab, 13 ref.

Descriptors: *Artificial recharge, *Groundwater mining, *Groundwater depletion, *India, *Alluvial aquifers, *Paleohydrology, Gujarat State, Aquitards, Irrigation water.

During the past few decades in the Mehsana region of the state of Gujarat, India, large-scale mining of groundwater for irrigation has depleted a series of alluvial aquifers. Within the overexploited area declines in water levels of a few to more than 25 m have occurred. A report, UNDP/CGWB (1976), on a regional groundwater investigation by the United Nations Development Programme and the Central Ground Water Board, Government of India, included the recommendation that artificial recharge in an area called the 'common recharge zone' might alleviate the diminishing groundwater resources of the overexploited area, which extends from several to about 60 km downgradient. To explore this further a Pilot Project for Artificial recharge was carried out in the early 1980's. The study concluded that local vertical downward leakage accounts for only 90% or more of natural recharge to the alluvial aquifer zones in the overexploited area and that only minimal contribution could migrate laterally from the common recharge zone. This vertical leakage finding contrasted with the UNDP/CGWB (1976) report findings that recharge in the common recharge zone might move more or less laterally through confined aquifers to the overexploited area. Thus, it warranted further hydrogeological analysis and interpretation. A closer look at available information on past climates and related paleohydrological evidence suggested sedimentary depositional environments for the Newer alluvium related to glacial and interglacial cycles of Pleistocene and Holocene (Recent) time. Such depositional environments, influenced by alternating wet and dry cycles, led to deposition of mainly fluvial sediments in lenses and with variable textures ranging from silt and clay to sand and gravel, rather than extensive continuous aquiclude/aquifer systems. The large groundwater withdrawals have increased downward percolation of recharge through leaky alluvial aquitards. (Author's abstract)
W90-01033

**NEW STATISTICAL GRAIN-SIZE METHOD FOR EVALUATING THE HYDRAULIC CONDUCTIVITY OF SANDY AQUIFERS.**
Nigeria Univ., Nsukka. Dept. of Geology.
K. O. Uma, B. C. E. Egboka, and K. M. Onuoha.
Journal of Hydrology JHYDA7, Vol. 108, No. 1-4, p 343-366, Jun 1989. 8 fig, 7 tab, 16 ref.

Descriptors: *Particle size,*Permeability, *Groundwater movement, *Sand aquifers, *Hydraulic conductivity, Transmissivity, Statistical methods, Pumping tests.

A new statistical grain-size method of evaluating the hydraulic conductivity (K) and transmissivity (T) of sandy aquifers is presented. The new equation is of the form K=Cd-squared (where d is the effective (or mean) diameter of the grains) and is similar to the existing equations, but in this case the coefficient C, which is normally taken as a constant, is actually shown to be a variable that depends on the nature of the geologic environment (source rock, transportation, deposition and post-deposition history, etc.). It is established that C for unconsolidated and poorly cemented sandy materials is 6.0, for moderately consolidated/cemented rocks, C=3.8, while for fairly well compacted and cemented rocks, its value is about 2.0. With these coefficients, the new statistical grain-size method gives K and T values that compare favorably with those determined from pumping test methods. (Author's abstract)
W90-01035

**SEDIMENTARY PETROLOGY: A GUIDE TO PALEOHYDROGEOLOGIC ANALYSES, EXAMPLE OF SANDSTONES FROM NORTHWEST GULF OF MEXICO.**
Texas Univ. at Austin. Dept. of Geological Sciences.
J. M. Sharp, and E. F. McBride.
Journal of Hydrology JHYDA7, Vol. 108, No. 1-4, p 367-386, Jun 1989. 11 fig, 1 tab, 66 ref. NSF grant EAR-8720040.

Descriptors: *Sandstones, *Sedimentary petrology, *Paleohydrology, *Gulf of Mexico, *Geohydrology, Geochemistry, Aquifers, Diagenesis.

Petrographic data have rarely been used in hydrogeologic studies, yet the aquifer's rocks record to varying extents the history of rock-water interaction in the aquifer. Recognition of paleohydrogeologic regimes can provide insights into porosity and permeability trends, groundwater chemistry, the formation of petroleum and mineral deposits, and the extrapolation of hydrogeological processes into the future (with applicability to problems of waste disposal). In the northwestern Gulf of Mexico Basin sandstones, diagenetic features are tabulated and related to paleohydrogeologic systems. Distinctive diagenetic patterns exist in the syndiagenetic, teleogenetic, and burial diagenetic regimes. Less well documented are the diagenetic patterns in sandstones within the low-grade metamorphic or free-convection regimes. These diagenetic features may be usable in other sandstone aquifers (or reservoirs) in identifying paleohydrogeologic systems and developing an aquifer's history. In the sandstones of the northwestern Gulf of Mexico (and probably in other passive continental margins), sandstone petrographic features are shown to record meteoric vs. overpressurized, compactional flow systems. (Author's abstract)
W90-01036

**FIELD MEASUREMENT AND ASSOCIATED CONTROLLING FACTORS FOR GROUNDWATER SEEPAGE IN A PIEDMONT IMPOUNDMENT.**
Virginia Univ., Charlottesville. Dept. of Environmental Sciences.
A. E. Bruckner, G. M. Hornberger, and A. L. Mills.
Hydrological Processes HYPRE3, Vol. 3, No. 3, p 223-235, Jul-Sep 1989. 11 fig, 2 tab, 23 ref.

Descriptors: *Surface-groundwater relations, *Lakes, *Groundwater movement, *Seepage, Drainage patterns, Artificial lakes, Lake Anna, Virginia.

Knowledge of groundwater seepage to and from lakes can be an important component of scientific investigations involving water and geochemical budgets. Measurements of groundwater seepage at Lake Anna, a man-made lake in central Virginia, show that inflow to the lake occurs even under dry summer conditions. Seepage rates were correlated with the elevation of the near-shore water table, which responded rapidly to rainfall events in the fractured rock terrain in which Lake Anna is located. Seepage rates did not decline uniformly with distance offshore. This result contrasts with those for lakes underlain by relatively homogeneous porous media where measurements generally confirm the prediction that seepage rates drop off exponentially with distance from shore. The along shore variability of seepage rates in Lake Anna was related to a topographic index that is used to describe drainage from hillslopes. This suggests that seepage in impoundments such as Lake Anna may be strongly controlled by drainage pathways that pre-dated the lake. (Author's abstract)
W90-01073

**STUDY CONCERNING THE RAPID FLOW OF FLOOD WATERS IN A SMALL CATCHMENT AREA OF A FORESTED ZONE IN BRITTANY (ETUDE DE LA FORMATION DE L'ECOULEMENT RAPIDE DE CRUE DANS UN PETIT BASSIN-VERSANT FORESTIER BRETON).**
Laboratoire de Geographie Physique, Meudon-Bellevue (France).
For primary bibliographic entry see Field 2E.
W90-01130

**OCCURRENCE OF RADON IN WELL SUPPLIES.**
American Water Works Service Co., Voorhees, NJ. System Water Quality Dept.
For primary bibliographic entry see Field 5F.
W90-01159

**OCCURRENCE OF RADON, RADIUM, AND URANIUM IN GROUNDWATER.**
Environmental Protection Agency, Cincinnati,

OH.
For primary bibliographic entry see Field 2K.
W90-01162

**GEOHYDROLOGY OF THE LAURA FRESHWATER LENS, MAJURO ATOLL: A HYDROGEOCHEMICAL APPROACH.**
Geological Survey, Honolulu, HI.
S. A. Anthony, F. L. Peterson, F. T. Mackenzie, and S. N. Hamlin.
Geological Society of America Bulletin BUGMAF, Vol. 101, No. 8, p 1066-1075, August 1989. 13 fig, 1 tab, 36 ref.

Descriptors: *Geochemistry, *Water chemistry, *Geohydrology, *Aquifers, *Groundwater movement, *Diagenesis, *Marshall Islands, Hydrologic aspects, Deposition, Seawater.

In small limestone islands, the depositional history and subsequent chemical interactions between groundwater and the aquifer host rock play critical roles in the occurrence, movement, and chemistry quality of ground water. The hydrogeochemistry of the Laura freshwater lens, Majuro atoll, Marshall Islands, is an example of these relations. Laura is underlain by two principal hydrologic units. The upper unit is a back-reef-marginal-lagoonal deposit which formed during the Holocene interglacial stage. The lower hydrologic unit consists of highly permeable limestone. The upper hydrologic unit contains a calcium bicarbonate rich freshwater lens, in which a potable freshwater nucleus as much as 14 m thick occurs on the lagoon side of the island. The highly permeable lower hydrologic unit contains seawater and truncates the freshwater seawater mixing zone. THe freshwater lens and associated freshwater seawater mixing zone are the site of continuously occurring diagenetic reactions that significantly affect the porosity and permeability of the aquifer. Nonequilibrium dissolution precipitation reactions, coupled with variations in CO2 input, control the chemical evolution of Laura groundwater. (Gadsby-PTT)
W90-01172

**GROUNDWATER QUALITY REGULATION: EXISTING GOVERNMENTAL AUTHORITY AND RECOMMENDED ROLES.**
Wisconsin Univ.-Madison. Dept. of Agricultural Economics.
For primary bibliographic entry see Field 5G.
W90-01173

**OPTIMAL VOLUMETRIC AND ECONOMIC GROUNDWATER MINING FOR THE ARKANSAS GRAND PRAIRIE.**
Utah State Univ., Logan. Dept. of Agricultural and Irrigation Engineering.
R. C. Peralta, and K. Kowalski.
Agricultural Water Management AWMADF, Vol. 15, No. 1, p 1-17, November 1988. 2 fig, 2 tab, 24 ref.

Descriptors: *Groundwater availability, *Aquifers, *Hydrologic models, *Water resources development, *Groundwater mining, *Groundwater irrigation, *Arkansas, Optimization, Drawdown, Water use, Model studies.

Models are demonstrated for development of optimal groundwater extraction strategies for an area in which the availability of water from other sources is anticipated by the end of the planning period. The study area: (1) has more wells than can be modeled individually, (2) has an existing piezometric surface that is stressed and not at steady state, and (3) is a portion of a larger aquifer system, the flow regime of which should not be disrupted. As a result, presented models incorporate, respectively: (1) cell-influence coefficients, instead of well-influence coefficients, (2) a convolution equation not previously demonstrated in optimizing groundwater mining, and (3) constant-head/restrained flux boundary conditions. Optimal 10-yr groundwater extraction volumes are presented for the intensively irrigated 4700 sq km Arkansas Grand Prairie. For the assumed conditions, strategies that maximize extraction volume are very similar to those that maximize the present value of net economic return resulting from agricultural production. It is shown that results are sensitive to limits on drawdown and changes in pumping with time. (Author's abstract)
W90-01218

**TREATMENT OF SPATIALLY VARIABLE GROUNDWATER LEVELS IN ONE-DIMENSIONAL STOCHASTIC UNSATURATED WATER-FLOW MODELING.**
Agricultural Univ., Wageningen (Netherlands). Dept. of Hydraulics and Catchment Hydrology.
J. W. Hopmans.
Agricultural Water Management AWMADF, Vol. 15, No. 1, p 19-36, November 1988. 8 fig, 3 tab, 23 ref.

Descriptors: *Soil water-groundwater relations, *Infiltration, *Stochastic models, *Hydrologic models, *Groundwater level, *Soil water, *Soil-water-plant relationships, *Surface-groundwater relations, Hydraulic properties, Boundary conditions, Hydrologic cycle, Evapotranspiration, Aeration zone.

A stochastic lower-boundary condition for an unsaturated water-flow domain is presented, which can be used in the numerical solution of the unsaturated water-flow equation for soils with a shallow groundwater table. The resulting stochastic model can be useful in studying the influence of spatially variable soil hydraulic properties and groundwater levels on soil water regime and plant transpiration. The lower-boundary condition employed assumes and exponential relation between the discharge of a watershed and the groundwater level at a specific location. Since it was found that groundwater levels were influenced by the presence of low-conductive clay in the soil profile, tubes from which groundwater levels were measured are divided into two classes. These classes were based on the presence of clay within the first 1.2 m of the soil profile. Scaling was then used to obtain a reference discharge-groundwater-level relationship for each class and for two years. This relationship, in combination with its frequency distribution of the set of scale-factor values for each class and year, can be used as the stochastic lower-boundary condition for an unsaturated water-flow model to simulated water transport in a soil with a shallow groundwater table. An application of such a variable lower-boundary condition, given in two simulation examples, shows that this condition can be used for an unsaturated water-flow model with a fluctuating groundwater table. (Author's abstract)
W90-01219

**PRECARIOUSNESS OR EVEN THE LACK OF RECHARGE OF THE PHREATIC AQUIFER IN THE NORTH SAHELIAN AREA OF CHAD DURING THE LAST 26 YEARS (LA PRECARITE OU MEME L'ABSENCE D'ALIMENTATION DE LA NAPPE PHREATIQUE EN ZONE NORD-SAHELIENNE DU TCHAD. RESULTATS D'UN QUART DE SIECLE DE SURVEILLANCE PIEZOMETRIQUE).**
Bureau de Recherches Geologiques et Minieres, Orleans (France).
D. Bichara, A. Safi, and J. L. Schneider.
Comptes Rendus de l'Academie des Sciences (Serie 2) CRASEV, Vol. 309, No. 5, p 493-496, 1989. 4 fig, 5 ref. English summary.

Descriptors: *Groundwater recharge, *Aquifers, *Water table decline, *Evapotranspiration, *Arid lands, Fluvial sediments, Chad, Sahel desert.

Piezometric and isotopic data show a recent recharge of the phreatic aquifer in some areas of the Ogolian erg to the North of Lake Chad, piezometric observations, started in 1963, show a continuous fall of the water table in tertiary or quaternary fluviolacustrine deposits where it is deeper than 30 meters below soil level. The fall which may reach an annual average of 0.06 corresponds to evapotranspiration losses, due to the aridity of the climate that has affected the Sahelian region for a very long time. (Author's abstract)
W90-01268

**MUTAGENICITY ON CHLORINATION OF PRODUCTS FORMED BY OZONATION OF NAPHTHORESORCINOL IN WATER.**
Setsunan Univ., Neyagawa (Japan). Div. of Environmental Health.
Y. Sayato, K. Nakamuro, and H. Ueno.
Mutation Research MUREAV, Vol. 226, No. 3, p 151-155, 1989. 3 fig, 7 ref.

Descriptors: *Water treatment, *Mutagenicity, *Drinking water, *Chlorination, *Ozonation, Ames test, Naphthoresorcinol.

The mutagenicity of products formed by chlorination after ozonation of naphthoresorcinol in drinking water was assayed with Salmonella typhimurium strains TA98 and TA100 in the presence and absence of S9 mix from phenobarbital-and 5,6-benzoflavone-induced rat liver. Ozonated and subsequently chlorinated naphthoresorcinol was directly mutagenic, as was ozonated naphthoresorcinol, in both strains tested. The mutagenic activity at chlorination with 8 equivalents of chlorine per mole of naphthoresorcinol after ozonation was markedly higher than that with ozonation only. Of the identified ozonation products of naphthoresorcinol, muconic acid, after chlorination with 2 or 4 equivalents of chlorine per mole of the compound, induced direct mutagenicity against TA98 and TA100. The chlorination of glyoxal with 0.5 and 1 chlorine equivalents per mole of the compound produced direct mutagenicity toward TA98. The following chlorination products of these compounds were identified using gas chromatography-mass spectroscopy by comparison with authentic standards: chloroform, chloral hydrate, dichloroacetics acid (as the methyl ester), and trichloroacetic acid (as the methyl ester). (Male-PTT)
W90-01274

**COMPUTER CODE FOR THE CALCULATION OF THE RELATIVE TRANSMISSIVITY DISTRIBUTION IN AN AQUIFER FOR STEADY STATE GROUNDWATER LEVELS.**
Orange Free State Univ., Bloemfontein (South Africa). Inst. for Groundwater Studies.
G. J. van Tonder.
Water SA WASADV, Vol. 15, No. 3, p 147-152, July 1989. 4 fig, 10 ref.

Descriptors: *Computer programs, *Transmissivity, *Groundwater movement, *Groundwater level, *Aquifers, Aquifer management, Geohydrology, Hydraulic head, South Africa, Water table, Spatial distribution.

A computer program to solve the inverse problem for transmissivities in an aquifer was developed. The underlying concept of the model is that the spatial distribution of groundwater levels, which is in a pseudo-steady state, is purely a function of the transmissivity distribution over the aquifer. The model was applied to the Atlantis aquifer, South Africa. The main objective of this application was to simulate the physical conditions prevailing in the aquifer and to optimize the future development of the production fields. During the calibration period, deficiencies encountered included too large elements in regions of steep groundwater gradients, and deficiencies in data regarding initial heads and hydraulic parameters. However, the model yielded a good comparison between observed and calculated water levels. (Friedmann-PTT)
W90-01404

**COMPUTER METHODS AND WATER RESOURCES: FIRST INTERNATIONAL CONFERENCE, MOROCCO 1988.**
For primary bibliographic entry see Field 7C.
W90-01409

**HYDROLOGICAL INVESTIGATION OF AN ARID AREA.**
Umm Al-Qura Univ., Mecca (Saudi Arabia). Faculty of Applied Sciences and Engineering.
A. A. S. Alfi.
IN: Computer Methods and Water Resources: First International Conference, Morocco, 1988. Vol. 3, Computational Hydrology. Computational

Mechanics Publications, Boston. 1988. p 51-62, 4 fig, 4 ref.

Descriptors: *Arid lands, *Hydrologic data collections, *Hydrologic maps, *Piezometers, *Geohydrology, *Aquifers, *Groundwater potential, Groundwater level, Resistivity, Stratification, Geological surveys.

A subtropical arid area is proposed to house a university campus. An investigation was conducted to define the hydrology and subsurface hydrology of the area, for possible use of its water resources and recommendations for better future use. An earth resistivity survey was carried out at 56 location for the evaluation of groundwater potential and subterranean stratification. Results were translated into profiles of sections. Three production wells with piezometric observation well were drilled to define the aquifer of the area, seasonal change and water quality. Profiles drawn from the results of the seismic survey were almost similar to those of the electrical survey. All aquifers in the area were unconfined with the level of bedrock playing a major role in defining groundwater slope, direction of flow and its quantity. Discharge of production wells were found to vary from 75 to 938 l/m and quality of water was found to be acceptable. Findings called for adequate open channels to be constructed along groundwater paths to take care of short duration floods predicted to occur within 50 years. (See also W90-01409) (Author's abstract)
W90-01414

**EFFECTS OF FORESTS ON WETLAND RUNOFF DURING SPRING.**
McMaster Univ., Hamilton (Ontario). Dept. of Geography.
For primary bibliographic entry see Field 2A.
W90-01460

**DETERMINATION OF HYDROLOGICAL FLOW PATHS AND ASSOCIATED HYDROCHEMISTRY IN FORESTED CATCHMENTS IN CENTRAL SCOTLAND.**
Imperial Coll. of Science and Technology, London (England).
For primary bibliographic entry see Field 5B.
W90-01472

**PALEORECHARGE, CLIMATOHYDROLOGIC VARIABILITY, AND WATER-RESOURCE MANAGEMENT.**
New Mexico Bureau of Mines and Mineral Resources, Socorro.
W. J. Stone.
IN: The Influence of Climate Change and Climatic Variability on the Hydrologic Regime and Water Resources, International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication No. 168, 1987. p 143-152, 3 fig, 1 tab, 20 ref.

Descriptors: *Climatology, *Rainfall variability, *Groundwater recharge, *Paleohydrology, *Paleoclimatology, Water management, *Australia, *New Mexico.

Changes in recharge through time document climatohydrologic variability. Modern and ancient recharge rates can be estimated and dated using a chloride mass-balance approach. An area studied in South Australia was shown to have been wetter before 13,500-16,000 yrs ago. In west central New Mexico, conditions were wetter prior to 7,000-17,000 yrs ago. Data from northwestern New Mexico show it was wetter there at the same general time and at younger intervals ending 1,000, 900 and 400 yrs ago. Dry periods preceded these wet intervals (occurring 1,000-2,000 and 10,000-14,000 yrs ago). Most of these times correspond to paleoclimatohydrologic regimes recognized in previous studies. These differences in recharge rates are important in water-resource management and waste-disposal planning. The rates can be used in modeling and to avoid groundwater mining. Higher previous recharge rates may be taken as worst-case values in designing waste-disposal facilities. (See also W90-01537) (Author's abstract)
W90-01550

**CLIMATE CHANGE AND WATER RESOURCES.**
World Meteorological Organization, Geneva (Switzerland).
For primary bibliographic entry see Field 4C.
W90-01573

**CLIMATIC VARIABILITY AND REGOLITH GROUNDWATER REGIME IN SOUTHWESTERN NIGERIA.**
Ife Univ. (Nigeria). Dept. of Geography.
For primary bibliographic entry see Field 2B.
W90-01581

**DETECTION OF NATURAL AND ARTIFICIAL CAUSES OF GROUNDWATER FLUCTUATIONS.**
Dienst Grondwaterverkenning TNO, Delft (Netherlands).
F. C. VanGeer, and P. R. Defize.
IN: The Influence of Climate Change and Climatic Variability on the Hydrologic Regime and Water Resources, International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication No. 168, 1987. p 597-606, 7 fig, 3 ref.

Descriptors: *Groundwater level, *Groundwater management, *Surface-groundwater relations, Model studies, Transfer/noise models.

Fluctuations and trends in the groundwater level are the result of a number of natural and artificial causes. Transfer/noise modelling has been applied to decompose observed groundwater level series in such a way that each cause of influence corresponds with a component of the groundwater level. Two applications are presented: (1) detection of the influence of a river stage on the groundwater level; and (2) detection of an artificial trend in the groundwater level. This process is applicable for: (1) decomposition of groundwater measurement series into natural and artificial components; (2) short-term forecasting of groundwater levels; (3) simulation of changes in the groundwater regime; and (4) a quick-screening of the data material in preliminary investigations. (See also W90-01537) (Author's abstract)
W90-01587

**MULTIPHASE FLOW IN POROUS MEDIA: DESCRIPTION AT THE PORE AND MACROSCOPIC SCALE.**
Thessaloniki Univ., Salonika (Greece). Lab. of Hydraulics and Hydraulic Works.
For primary bibliographic entry see Field 2G.
W90-01592

**PREDICTION OF WATER TABLE MOUND DEVELOPMENT AND AQUIFER RECHARGE FROM AN INFILTRATION AREA.**
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
H. J. Morel-Seytoux, and C. Miracapillo.
IN: Unsaturated Flow in Hydrologic Modeling: Theory and Practice. Kluwer Academic Publishers, Boston. 1989. p 241-272, 12 fig, 1 tab, 19 ref.

Descriptors: *Water table, *Unconfined aquifers, *Groundwater recharge, *Soil water, *Intermittent streams, *Infiltration, *Mathematical analysis, Wadi, Aquifers, Storm seepage.

Typically intermittent streams (wadis) and zones of infiltration during and shortly after a rain or a flood are not in permanent hydraulic connection with the underlying water-table aquifer. Due to the frequent presence of a clogged layer the water flow below the infiltration zone is often unsaturated. Recharge occurs only after the unsaturated wetting front reaches the water-table. On the other hand, long after infiltration has ceased at the soil surface, recharge continues from the unsaturated storage which has accumulated above the water table during the infiltration phase. This distinct phase of recharge after infiltration has stopped is called the drainage phase. The problem is two or three-dimensional in nature. To simplify the predictive tool and make it very practical, the multidimensional character of the flow problem is rendered, approximately but effectively, by a special technique that consists of matching two unidimensional flows, a vertical and a horizontal one. Practical examples illustrate the influence of the parameters on the water table level below the infiltrating area and on the lateral recharge rate into the part of the aquifer which is not overlain by the river or infiltration basin bed. Comparison with field observations shows the technique to be accurate, inexpensive and easy to apply. (See also W90-01590) (Author's abstract)
W90-01599

**NUMERICAL SIMULATION OF RICHARDS EQUATION: CURRENT APPROACHES AND AN ALTERNATE PERSPECTIVE.**
California Univ., Berkeley. Earth Sciences Div.
For primary bibliographic entry see Field 2G.
W90-01602

**SPATIALLY DISTRIBUTED MODELLING: CONCEPTUAL APPROACH, COUPLING SURFACE WATER AND GROUNDWATER.**
Ecole Nationale Superieure des Mines de Paris, Fontainebleau (France). Centre d'Information Geologique.
For primary bibliographic entry see Field 7C.
W90-01606

**INFLUENCE OF SPATIAL VARIABILITY OF SATURATED HYDRAULIC CONDUCTIVITY ON THE INFILTRATION PROCESS.**
Technical Univ. of Lisbon (Portugal). High Inst. of Agronomy.
For primary bibliographic entry see Field 2G.
W90-01607

**GROUNDWATER RECHARGE IN URBAN AREAS.**
Birmingham Univ. (England). Dept. of Geological Sciences.
D. N. Lerner.
IN: Hydrological Processes and Water Management in Urban Areas. Proceedings of the International Symposium 24-29 April 1988, Duisburg, West Germany. International Hydrological Programme of UNESCO Publication, 1988. p 69-76, 2 fig, 2 tab, 14 ref.

Descriptors: *Groundwater recharge, *Urban areas, *Urban hydrology, *Recharge, *Infiltration, Urbanization, Groundwater movement.

The two interlinked networks of hydrological pathways in urban areas (natural pathways and water supply-sewage pathways) are described with particular reference to the link with groundwater. As well as reducing direct recharge, urbanization creates new pathways and sources of water for recharge, including leaking water mains, sewers, septic tanks and soakaways. The net effect is often an increase in recharge to pre-urbanization rates; or higher in dry climates and cities with high densities, and large imported water supplies. (See also W90-01612) (Author's abstract)
W90-01620

**GROUNDWATER RESPONSE IN THE URBAN SECTORS OF CAIRO ENVIRONS, EGYPT.**
Qatar Univ., Doha. Dept. of Geology.
For primary bibliographic entry see Field 4C.
W90-01660

**EFFECTS OF BANKWELL FILTRATION ON THE SAFE GROUND WATER YIELD IN THE COLOGNE AREA.**
For primary bibliographic entry see Field 4B.
W90-01661

**QUANTITY AND QUALITY OF GROUNDWATER BENEATH AN INDUSTRIAL CONURBATION--BIRMINGHAM, UK.**
Birmingham Univ. (England). Dept. of Geological Sciences.
J. W. Lloyd, D. N. Lerner, M. O. Rivett, and M. Ford.
IN: Hydrological Processes and Water Management in Urban Areas. Proceedings of the International Symposium 24-29 April 1988, Duisburg, West Germany. International Hydrological Programme of UNESCO Publication, 1988. p 445-452, 5 fig, 1 tab, 3 ref.

Descriptors: *Groundwater quality, *Groundwater budget, *Urbanization, *Urban areas, *England, Aquifers, Nitrates, Chlorides, Trichloroethylene, Organic compounds, Groundwater pollution, Birmingham.

Since the 1960's groundwater heads have been rising noticeably beneath Birmingham, England principally due to reducing abstraction. Despite the almost complete urbanization of the aquifer surface, potential recharge is at least as high as it was before the city was built. There is sufficient leakage from water mains and sewers to make up for the reduced infiltration at the surface. The marked change in groundwater conditions has prompted interest in groundwater quality, and both the inorganic and organic quality of the groundwater are currently being studied. First indications are of widespread worsening inorganic quality, with high nitrates, chlorides and certain trace elements. Chlorinated organic solvents (e.g. trichloroethylene) are widespread, but there is little evidence to date of other organic pollutants. (See also W90-01612) (Author's abstract)
W90-01662

**INFLUENCE OF URBANIZATION ON THE QUALITY OF GROUNDWATER.**
Slovenska Vysoka Skola Technicka, Bratislava (Czechoslovakia).
For primary bibliographic entry see Field 4C.
W90-01663

**EFFECT OF URBANIZATION ON A SHALLOW QUATERNARY AQUIFER.**
Technische Univ. Muenchen (Germany, F.R.). Lehrstuhl fuer Hydrogeologie und Hydrochemie.
For primary bibliographic entry see Field 4C.
W90-01664

**IMPACT OF AN URBAN AREA ON THE HYDROCHEMISTRY OF A SHALLOW GROUNDWATER (ALLUVIAL RESERVOIR) TOWN OF NARBONNE, FRANCE.**
Montpellier-2 Univ. (France). Lab. d'Hydrogeologie.
For primary bibliographic entry see Field 4C.
W90-01667

**POSSIBILITIES FOR GROUNDWATER DEVELOPMENT FOR THE CITY OF JAKARTA, INDONESIA.**
Bundesanstalt fuer Geowissenschaften und Rohstoffe, Hanover (Germany, F.R.).
G. Schmidt, B. Soefner, and P. Soekardi.
IN: Hydrological Processes and Water Management in Urban Areas. Proceedings of the International Symposium 24-29 April 1988, Duisburg, West Germany. International Hydrological Programme of UNESCO Publication, 1988. p 505-516, 8 fig, 3 ref.

Descriptors: *Water resources development, *Groundwater budget, *Groundwater management, *Indonesia, Water resources development, Groundwater mining, Saline water intrusion, Groundwater pollution, Mathematical models, Geohydrology, Djakarta.

Groundwater resources for the water supply of the city of Jakarta, Indonesia, are limited with respect to quantity and quality. In response to the present over-exploitation of the deeper parts of the aquifer system, piezometric heads have regionally dropped below sea level. Sea water encroachment and land subsidence have been recorded as a consequence of the head decline in the northern and central city districts. Shallow groundwater is exposed to many sources of contamination. On the basis of recent geohydrological investigations and available data on groundwater exploitation in Jakarta, a three-dimensional numerical groundwater model was developed to simulate the present situation and the possible future development of the groundwater resources in the area. Prognoses are made that the present abstraction from the deep aquifer system of 47 cu m/yr can be maintained and that the velocity of sea water encroachment can be reduced if the present centers of abstraction can be shifted from positions near to the coast and further inland to the south. (See also W90-01612) (Author's abstract)
W90-01669

**IMPACTS OF URBANIZATION OF THE GREATER CAIRO AREA ON THE GROUND WATER IN THE UNDERLYING AQUIFER.**
International Inst. for Hydraulic and Environmental Engineering, Delft (Netherlands).
For primary bibliographic entry see Field 4C.
W90-01670

**HYDROGEOLOGICAL STUDIES WITHIN THE FRAMEWORK OF AN ECOLOGICAL RISK ANALYSIS OF HARBOUR MUD DEPOSITS.**
Arbeitsgemeinschaft Hydrogeologie und Umweltschutz, Aachen (Germany, F.R.).
For primary bibliographic entry see Field 4C.
W90-01673

**GROUNDWATER POLLUTION BY TILBURG'S GAS PLANT.**
Iwaco B.V., Boxtel (Netherlands).
For primary bibliographic entry see Field 4C.
W90-01677

**IMPACTS ON GROUNDWATER QUALITY AND GROUNDWATER USE IN A HIGH POPULATED AND INDUSTRIALIZED URBAN REGION.**
Technologieberatung Grundwasser und Umwelt Koblenz, West Germany.
For primary bibliographic entry see Field 4C.
W90-01680

**GROUNDWATER CONTAMINATION: SOURCES, CONTROL, AND PREVENTIVE MEASURES.**
Albuquerque City Enviromental Compliance Dept., NM.
For primary bibliographic entry see Field 5G.
W90-01704

**INSTALLATION RESTORATION PROGRAM, STAGE 3: MCCLELLAN AIR FORCE BASE, SEMIANNUAL INFORMAL TECHNICAL REPORT.**
Radian Corp., Sacramento, CA.
For primary bibliographic entry see Field 5G.
W90-01707

**INTERIM HYDROGEOLOGIC CHARACTERIZATION REPORT AND GROUNDWATER MONITORING SYSTEM FOR THE NONRADIOACTIVE DANGEROUS WASTE LANDFILL, HANFORD SITE, WASHINGTON.**
Westinghouse Hanford Co., Richland, WA.
For primary bibliographic entry see Field 5G.
W90-01708

**PERFORMANCE OF AIR STRIPPING AND GAO FOR SOC AND VOC REMOVAL FROM GROUNDWATER.**
Michigan Technological Univ., Houghton.
For primary bibliographic entry see Field 5F.
W90-01709

**MODELING GROUNDWATER TRANSPORT OF DISSOLVED GASOLINE.**
Argonne National Lab., IL.
For primary bibliographic entry see Field 5B.
W90-01710

**SUPERFUND RECORD OF DECISION: KEEFE ENVIRONMENT, NH.**
Environmental Protection Agency, Washington, DC. Office of Emergency and Remedial Response.
For primary bibliographic entry see Field 5G.
W90-01715

**EVOLUTION OF THE GROUNDWATER CHEMISTRY AROUND A NUCLEAR WASTE REPOSITORY.**
UKAEA Atomic Energy Research Establishment, Harwell (England). Theoretical Physics Div.
For primary bibliographic entry see Field 5G.
W90-01722

**ISOTOPE AND HYDROGEOCHEMICAL STUDIES IN WATERS FROM THE RIO VERDE BASIN BAHIA (ESTUDOS ISOTOPICOS E HIDROQUIMICOS EM AGUAS NA BACIA DO RIO VERDE BAHIA).**
G. A. Tavares.
Available from National Technical Information Service, Springfield, VA 22161 as DE87703722/GAR, Price codes: A06 in paper copy, A01 in microfiche. Report INIS-BR-826. 1983. 108p, 28 fig, 17 tab, 77 ref, append. English summary.

Descriptors: *Geochemistry, *Water chemistry, *Groundwater, *Radioactive dating, Chemical analysis, Carbon radioisotopes, Wells, Hydrologic cycle.

In situ measurements of water level, temperature and pH in 8 wells of the limestone rocks of the Bambui and Caatinga Formation, in the Rio Verde basin, were taken in August, September, October, November and December 1979 and in April and October of 1980. Samples of precipitation and surface waters in the region and groundwater of these wells were analyzed for the content of Ca(+2), Mg(+2), Na(+), K(+), SO4(--), HCO3(-), Cl(-), and isotopic ratios D/H and O18/016. For the groundwater samples the radiocarbon activity and isotopic ratio C13/C12 of the dissolved carbonates were determined. The parameters determined were used to analyze the factors controlling the groundwaters in the region within the hydrological cycle as well as an eventual leak into the region of water from the nearby reservoir of Sobradinho. No relationship was found between the groundwaters and the Sobradinho reservoir. Their apparent carbon-14 ages range from 2,300 to 13,640 years. As all samples come from a small area this indicates a heterogeneous and complex aquifer. The data on isotopic ratio D/H and O18/O16 and the high carbon-14 ages of the groundwater suggest neither direct recharge from precipitation nor correlations between the waters of Rio Verde and the aquifer. The chemical data of the slightly saline groundwater with differences in the chemical ratios with respect to the surface samples suggests some dissolution in addition to evaporation as the mechanisms that control the salt content in the aquifer. (Author's abstract)
W90-01745

**APPLICATION OF GENE PROBES TO THE DETECTION OF ENTEROVIRUSES IN GROUNDWATER.**
Arizona Univ., Tucson. Dept. of Microbiology and Immunology.
For primary bibliographic entry see Field 5A.
W90-01771

**SCIENTIFIC-TECHNICAL DEMANDS FOR THE SANITATION OF CONTAMINATED SITES--PART I: WORKING-OUT A VALUATION SCHEME FOR MIGRATION BEHAVIOR OF SUBSTANCES UNDERGROUND (NATURWISSENSCHAFTLICH-TECHNISCHE ANFORDERUNGEN AN DIE SANIERUNG KONTAMINIERTER STANDORT--TEIL I: ERARBEITUNG EINES SCHEMAS ZUR BEWER-**

**TUNG DES MIGRATIONSVERNALTENS VON STOFFEN IM UNTERGRUND).**
Umweltbundesamt, Berlin (Germany, F.R.).
For primary bibliographic entry see Field 5B.
W90-01791

**SPECIFIC HYDROMETRY OF KARST REGIONS.**
Split Univ. (Yugoslavia). Faculty of Civil Engineering Sciences.
For primary bibliographic entry see Field 7B.
W90-01824

**COMPARISON BETWEEN THE GROUNDWATER QUALITY IN AN INTERMOUNTAINOUS AND A COASTAL PLAIN IN YEMEN ARAB REPUBLIC.**
San'a Univ. (Yemen). Dept. of Geology.
For primary bibliographic entry see Field 2K.
W90-01835

**ANOMALOUS HEAT FLOW AND TEMPERATURES ASSOCIATED WITH SUBGLACIAL WATER FLOW.**
Alaska Univ., Fairbanks. Geophysical Inst.
For primary bibliographic entry see Field 2C.
W90-01895

## 2G. Water In Soils

**ESTIMATION OF SOIL HYDRAULIC PROPERTIES AND THEIR UNCERTAINTY FROM PARTICLE SIZE DISTRIBUTION DATA.**
Virginia Polytechnic Inst. and State Univ., Blacksburg. Center for Environmental and Hazardous Material Studies.
S. Mishra, J. C. Parker, and N. Singhal.
Journal of Hydrology JHYDA7, Vol. 108, No. 1-4, p 1-18, Jun 1989. 7 fig, 3 tab, 23 ref. Electrical Power Research Institute contract RP2485-06 and American Petroleum Institute contract WM-5-324-7.

Descriptors: *Soil properties, *Hydraulic properties, *Particle size, *Soil water, *Hydraulic conductivity, Capillary pressure, Statistical methods, Uncertainty.

A unified approach to the estimation of soil hydraulic properties and their uncertainty from particle size distribution data is presented. Soil hydraulic properties are represented by the parametric models of Van Genuchten and/or Brooks and Corey. Particle size distribution data are used to generate theoretical soil-water retention data using a modified form of the model proposed by Arya and Paris, which was calibrated in this study using a data set of 250 soil samples. Parameters in the Van Genuchten model are fitted to the predicted water content-capillary pressure data by nonlinear regression methods and may be optionally converted to equivalent Brooks-Corey retention parameters using an empirical procedure. Saturated conductivity is estimated from particle size data using a modified Kozeny-Carman equation which was developed from the data set of 250 soil samples. Uncertainty in parameter estimates is evaluated using first-order error analysis methods. Application of the proposed methodology to three soils which were not in the calibration set indicated water content-capillary pressure relations can be predicted with reasonable accuracy and precision. Uncertainty in predicted saturated hydraulic conductivity will be rather large making direct measurement of this variable highly desirable. (Author's abstract)
W90-01017

**EFFECTS OF PARAMETER UNCERTAINTY ON PREDICTIONS OF UNSATURATED FLOW.**
Virginia Polytechnic Inst. and State Univ., Blacksburg. Center for Environmental and Hazardous Material Studies.
S. Mishra, and J. C. Parker.
Journal of Hydrology JHYDA7, Vol. 108, No. 1-4, p 19-33, Jun 1989. 4 fig, 4 tab, 20 ref. American Petroleum Institute contract WM-5-324-7.

Descriptors: *Unsaturated flow, *Soil water, *Path of pollutants, *Error analysis, Statistical analysis, Statistical methods, Monte Carlo method, Simulation, Rainfall.

Proper prediction of fluid flow in the unsaturated zone is vital to the study of the migration of contaminants as fluid flow and chemical transport are strongly coupled processes. This study uses first-order first and second moment analysis to evaluate the error in predictions of unsaturated flow models caused by parameter uncertainty, expressed in terms of a mean value for each parameter and an error covariance matrix. These are related to the mean and variance in the model predictions by a first-order Taylor expansion. Two applications of the methodology are presented. The first involves the estimation of parameters and their error covariance matrix from particle size distribution data for a layered field soil. These are used to predict water contents and associated errors for a static retention test and a dynamic drainage experiment. The second case involves parameter estimation using a numerical inversion method from a transient flow experiment for a hypothetical homogeneous soil. Predictions of water contents and their errors for a rainfall-redistribution event using the estimated parameters compare well with predictions corresponding to actual parameters. Uncertainty predictions with the first-order error analysis procedure also agree well with results of a Monte Carlo simulation study. (Author's abstract)
W90-01018

**SEEPAGE THROUGH A HAZARDOUS-WASTE TRENCH COVER.**
Geological Survey, Denver, CO.
For primary bibliographic entry see Field 5B.
W90-01026

**COMPARISONS OF THE UNSATURATED HYDRAULIC CONDUCTIVITY OF A COARSE-TEXTURED SOIL AS DETERMINED IN THE FIELDS, IN THE LABORATORY, AND WITH MATHEMATICAL MODELS.**
Ghent Rijksuniversiteit (Belgium). Lab. of Soil Physics, Soil Conditioning and Horticultural Soil Science.
P. Michiels, R. Hartmann, and E. D. Strooper.
Soil Science SOSCAK, Vol 47, No. 4, p 299-304, April 1989. 3 fig, 3 tab, 16 ref.

Descriptors: *Hydraulic conductivity, *Soil texture, *Soil water, *Sand, Model studies, Laboratory studies, Field tests, Water retention,, Drainage.

Several methods for determining the hydraulic conductivity-volumetric water content relationship have been developed. Three different methods for determining hydraulic conductivity values were evaluated on a sand dune soil. The first method is known as the internal drainage instantaneous profile method and was carried out on the field. The second method was analogous to the first but was carried but in the laboratory. The results obtained by these two experimental techniques were then used as a reference for comparing with the hydraulic conductivity functions predicted by the third method, mathematical models. For this numerical approach, the Jackson and the Mualem formulation was selected. For the coarse-textured soil used in this investigation, all three methods resulted in hydraulic conductivity functions that were in fairly good agreement. Moreover, the differences between the laboratory experiment and the field experiment were greater than the deviations of the mathematical models, although subtle differences were found. It seemed that Mualem's model for calculating the hydraulic conductivity function, combined with the van Genuchten equation for the soil water retention equation, is the easiest to use and leads to the most accurate results for this particular soil. (Author's abstract)
W90-01063

**SOIL HYDROPHOBIC EFFECTS ON INFILTRATION AND CATCHMENT RUNOFF.**
Department of Primary Industries and Energy, Canberra (Australia). Bureau of Rural Resources.
G. J. Burch, I. D. Moore, and J. Burns.
Hydrological Processes HYPRE3, Vol. 3, No. 3, p 211-222, Jul-Sep 1989. 8 fig, 4 tab, 18 ref.

Descriptors: *Rainfall-runoff relationships, *Australia, *Water repellent soils, *Forest soils, *Soil absorption capacity, Drought, Water deficit, Infiltration, Rainfall infiltration, Soil properties, Catchment areas, Storm runoff, Runoff, Soil water, Grasslands.

After dry summers or drought, eucalypt forest soils at two sites in southeastern Australia developed hydrophobic or non-wetting surface characteristics that reduced infiltration, measured using a sprinkling infiltrometer. At one site the development of hydrophobic conditions caused the rainfall to runoff conversion efficiency of a forested catchment to increase from 5% to 15%. Under non-hydrophobic conditions at this site, grassland always generated more runoff than forest. However, one major rainfall-runoff was recorded at a time of highly hydrophobic forest soil conditions and this storm generated greater runoff on the forested catchment than the grassland catchment. At the second site forest soils have naturally highly conductive surface layers because of a dense network of macropores and pathways for preferential flow. Hydrophobic conditions produced by drought caused soil water movement to be confined to only a few of the larger macropores exposed to surface ponded water. Even so, infiltration rates remained relatively high so that the impacts of hydrophobic soils were not translated into increased catchment runoff as at the first site. (Author's abstract)
W90-01072

**USE OF SOIL MOISTURE STATE INDICATORS IN A RAINFALL-RUNOFF MODEL (UTILISATION D'INDICATEURS DE L'ETAT HYDRIQUE DU SOL DANS UN MODELE PLUIE-DEBIT).**
Centre National du Machinisme Agricole, du Genie Rural, des Eaux et des Forets, Antony (France).
For primary bibliographic entry see Field 7C.
W90-01134

**CRITICAL ASSESSMENT OF THE ROLE OF MEASURED HYDRAULIC PROPERTIES IN THE SIMULATION OF ABSORPTION, INFILTRATION AND REDISTRIBUTION OF SOIL WATER.**
Massey Univ., Palmerston North (New Zealand). Dept. of Soil Science.
D. R. Scotter, B. E. Clothier, and T. J. Sauer.
Agricultural Water Management AWMADF, Vol. 15, No. 1, p 73-86, November 1988. 6 fig, 24 ref.

Descriptors: *Soil water, *Percolation, *Infiltration, *Absorption, *Saturation zone, *Hydraulic properties, *Hydraulic conductivity, Simulation, Computer programs, Sand, Soil horizon.

Free-water absorption and infiltration were measured in a repacked fine sand. Redistribution following constant-flux infiltration was also measured. These processes were then computer-simulated using independently measured soil water retentivity and conductivity data. Neither free-water absorption, nor ponded infiltration could be accurately simulated, as they depended so critically on the soil water retentivity near saturation, where errors of observation prohibit accurate measurement. For simulating redistribution, useful answers were obtained even when hysteresis was ignored. But redistribution was grossly over-predicted when the Campbell-Brooks and Corey method was used for inferring the unsaturated hydraulic conductivity from saturated conductivity and retentivity data. Campbell has produced a simple yet elegant computer simulation package for soil water movement. But to use it successfully required alternative ways of evaluating the hydraulic parameters. Ponded infiltration was successfully simulated only when the sorptivity was used as an independent input. To simulate redistribution required accurate determination of the unsaturated hydrau-

lic conductivity. For software such as Campbell's to be used effectively, more effort and physical insight needs to be directed toward appropriate characterization of the critical hydraulic properties. This physical emphasis will lessen the likelihood of such useful software generating erroneus and misleading results. (Author's abstract)
W90-01223

**ENHANCEMENT OF CROP YIELDS FROM SUBSURFACE DRAINS WITH VARIOUS ENVELOPES.**
Soil and Water Research Inst., Giza (Egypt).
For primary bibliographic entry see Field 3F.
W90-01226

**DETERMINING PERCOLATION LOSSES OF PACKED CLAY SOIL FROM TENSIOMETER DATA.**
Water and Land Management Inst., Aurangabad (India).
P. V. Singh, D. Pal, S. B. Varade, and S. Kar.
Agricultural Water Management AWMADF, Vol. 15, No. 2, p 189-195, December 1988. 4 fig, 2 tab, 6 ref.

Descriptors: *Percolation, *Soil water, *Clays, *Leaching, *Hydraulic conductivity, *Water loss, Irrigation, Lysimeters, Hydraulic properties, Tensiometers, Surface-groundwater relations.

The measurement or prediction of percolation losses in field situations is of great practical significance for efficient irrigation and for determination of the leaching requirement, particularly of clayey soils where impeded percolation occurs. Hydraulic properties and water losses in packed Ashutia clay soil were determined under prevented-evaporation and free-evaporation conditions using lysimeter and tensiometric techniques. Hydraulic conductivity was determined as a function of soil moisture content using percolation flux computed. An exponential relationship between hydraulic conductivity and soil water content was found. The percolation and evaporation-plus-percolation fluxes estimated from tensiometer readings under prevent and free-evaporation conditions, respectively, matched with profile water losses from lysimeter measurements. The error ranged between 0.01 and 0.82 mm/day with high correlation coefficient indicating that water loss from a soil profile can be estimated from tensiometer readings. (Author's abstract)
W90-01230

**IN SITU HYDRAULIC CONDUCTIVITY TESTS FOR COMPACTED CLAY.**
Texas Univ., Austin. Dept. of Civil Engineering.
D. E. Daniel.
Journal of Geotechnical Engineering (ASCE) JGENDZ, Vol. 15, No. 9, 1989, p. 1205-1226, 11 fig, 9 tab, 43 ref.

Descriptors: *Hydraulic conductivity, *Measuring instruments, *Clays, *Compacted soils, Infiltrometers, Permeameters, Lysimeters, In situ tests.

The state of the art for in situ conductivity testing of compacted clay soils is summarized. Nine methods of testing are reviewed: (1) the Boutwell permeameter; (2) constant-head borehole permeameters, e.g., the Guelph permeameter; (3) pourous probes, e.g. the BAT device; (4) open, single-ring infiltrometers; (5) open, double-ring infiltrometers; (6) closed, single-ring infiltrometers; (7) sealed, double-ring infiltrometers; (8) the air-entry permeameter; and (9) lysimeter pans. Installation procedures are given, equations for calculating hydraulic conductivity are presented, simplifying assumptions are listed, and case histories are reviewed. Each type of permeameter has advantages. The Boutwell permeameter is especially convenient for measurement of the vertical and horizontal hydraulic conductivity. Borehole permeameters and porous probes provide data relatively quickly but permeate a relatively small volume of soil. Of the permeameters that can permeate a large volume of soil, the sealed double-ring infiltrometer and pan lysimeter are the most versatile. (Author's abstract)
W90-01273

**APPLICATION OF CLASSICAL PHYSICS TRANSPORT THEORY TO WATER MOVEMENT IN SOIL: DEVELOPMENT AND DEFICIENCIES.**
Rothamsted Experimental Station, Harpenden (England). Inst. of Arable Crops Research.
G. D. Towner.
Journal of Soil Science JSSCAH, Vol. 40, No. 2, p 251-260, June 1989. 74 ref.

Descriptors: *Reviews, *Soil water, *Fluid mechanics, *Hydraulic conductivity, Diffusivity, Mathematical equations, Soil porosity, Physical properties, Hydrodynamics.

The history of the application of classical physics to the movement of soil water is reviewed. The development of soil water transport theory is essentially that of the application of classical physical theories that were originally derived for the perceived analogous transport of fluids, heat and electricity in continua. Much of soil-water transport theory was developed by Buckingham at the turn of the century, but it took several decades for it to become well understood and established. An inability to solve partial differential equations with water-dependent transport coefficients hampered a rigorous analysis and a proper interpretation of early experiments. The theory has been well proved in the laboratory, but application to the field has been less than successful because of heterogeneity and macropores. More recent theories based on other principles have not yet received adequate testing. Future work should extend the established theory as well as develop and test new ones. In analyzing flow in soils containing macropores, there are three scenarios to consider: the macropores are sparse and well-defined geometrically; the macropores are distributed densely and uniformly throughout the soil; and, the macropores are distributed too densely to be included under either of the above two scenarios. Classical physics is still, generally, more than adequate for solving many day to day soil water transport problems. (Friedmann-PTT)
W90-01391

**DETERMINATION OF THE EXPONENTIAL UNSATURATED HYDRAULIC CONDUCTIVITY FUNCTION BY PARAMETER IDENTIFICATION.**
Agricultural Univ. of Warsaw (Poland). Dept. of Land Reclamation.
T. Brandyk, R. Romanowicz, and K. Skapski.
Journal of Soil Science JSSCAH, Vol. 40, No. 2, p 261-267, June 1989. 4 fig, 14 ref.

Descriptors: *Hydraulic conductivity, *Soil water, *Soil porosity, *Muck soils, *Aeration zone, *Peat, Soil profiles, Soil horizons, Diffusivity, Percolation, Parameterization, Soil physical properties.

The parameter identification technique for the evaluation of the exponential unsaturated hydraulic conductivity is explored. The identification is performed using the indirect approach with an output error criterion for steady soil moisture flow through peat-muck soil columns. The identification procedure uses the Levenberg-Marquardt algorithm to the solution of the stated least-square optimization problem. Examination of the evaluated parameters from laboratory experiments justifies the use of this simple identification method for the whole soil profile when the variation of the soil properties in the soil profile is not too large. For layered soil profiles with relatively large differences of soil properties between layers, it is shown that parameters of the exponential function must be evaluated separately for each layer. (Author's abstract)
W90-01392

**MAPPING SURFACE SOIL MOISTURE WITH L-BAND RADIOMETRIC MEASUREMENTS.**
National Aeronautics and Space Administration, Greenbelt, MD. Goddard Space Flight Center.
J. R. Wang, J. C. Shiue, T. J. Schmugge, and E. T. Engman.
Remote Sensing of the Environment RSEEA7, Vol. 27, No. 3, p 305-312, March 1989. 4 fig, 2 tab, 11 ref.

Descriptors: *Soil water, *Temporal distribution, *Soil moisture meters, *Remote sensing, *Radiometry, *Soil moisture retention, Catchment areas, Surface water, Rainfall impact, Watersheds, Mapping.

It has been shown previously that radiometry is capable of producing two-dimensional brightness temperature maps which can be used to infer spatial soil moisture patterns. A calibration of the radiometric response with appropriate ground truth data should enable one to obtain the soil moisture maps. Spatial soil moisture patterns were temporally mapped as the watersheds dried down from a saturated state. Radiometric measurements were made over two small watersheds with a four-beam pushbroom microwave radiometer aboard the NASA C-130 aircraft, during a dry-down period following a heavy rainfall in May and June 1987. The two watersheds were in the tall grass prairie region of Kansas. One of them was burned about 2 months prior to the measurements and the other was not burned for more than a year. Surface (0-5 cm) soil moisture data were collected close to the times of the aircraft measurements and correlated with the corresponding radiometric measurements. This established a relationship required for the mapping of surface soil moisture watersheds. It is shown that the radiometric sensitivity to soil moisture variation is higher in the burned watershed than in the unburned watershed. A comparison of the derived soil moisture contours shows that the burned watershed loses surface soil moisture more rapidly than the unburned watershed. Vegetation can have a very significant effect on the retrieved soil moisture values and the magnitude of that effect is generally proportional to the biomass of the overlying vegetation. (Friedmann-PTT)
W90-01394

**ROOT ZONE DRAINAGE FROM A HUMID FOREST SOIL IN THE WEST COAST OF CANADA.**
British Columbia Ministry of Forests, Kamloops. Hydrology Research Section.
J. D. Cheng.
IN: Forest Hydrology and Watershed Management. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication No. 167, 1987. p 377-386, 4 fig, 1 tab, 12 ref.

Descriptors: *Forest hydrology, *Forest soils, *Root zone, *Lysimeters, *Subsoil drainage, Darcy-Weisbach equation, Hydraulic conductivity, Hydraulic gradient, Hydrologic budget, Drainage, Streamflow, Rainfall, Soil water.

Root zone drainage from a humid forest soil was evaluated by a tension lysimeter system and the Darcy's equation method. Suction on the lysimeter plate, which had improved hydraulic contact with the soil, was adjusted according to the tension in the surrounding soil. Field determined soil hydraulic conductivity and hydraulic gradient data were used in the Darcy's equation method. Drainages measured by the two methods were similar with the lysimeter method giving slightly higher values, and drainage amounts during two drying periods agreed well with those estimated from a water balance method. The variations of root zone drainage were closely related to those of rainfall and streamflow of the small surrounding watershed. Sources of error associated with the two methods are discussed and improvements are suggested. (See also W90-01432) (Author's abstract)
W90-01467

**SOIL WATER BALANCE MODEL FOR PARTITIONING WATER USE AMONG CROP TREES, EVAPORATION, AND COMPETING VEGETATION.**
Oregon State Univ., Corvallis. Dept. of Soil Science.
S. W. Childs, C. Costello, and A. L. Flint.
IN: Forest Hydrology and Watershed Management. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication No. 167,

1987. p 387-399, 5 fig, 3 tab, 20 ref.

Descriptors: *Soil-water-plant relationships, *Hydrologic budget, *Soil water, Model studies, Climates, Vegetation.

A model which calculates the soil water balance given input measurements or estimates of climate, soil properties, and vegetative cover conditions is presented. The input data requirement is kept to a minimum in order to maximize the utility of the model in situations where few measurements are available. Model sensitivity to error in input values is assessed. The model may be used to quantify the probability of soil water shortage if several seasons of varying climatic data are available. Verification of the model calculation of the soil water balance is shown for 4 common reforestation treatments: shading, mulching, vegetation control and no treatment. The verification experiments show that the model can calculate the measured treatment differences found in a detailed soil water balance study. In addition, a sensitivity analysis of the model shows that the model is not overly sensitive to errors in estimating soil properties and cover percentages. (See also W90-01432) (Author's abstract)
W90-01468

**PRELIMINARY ASSESSMENT OF SOIL HYDRAULIC PROPERTIES, AND THEIR IMPLICATIONS FOR AGRO FORESTRY MANAGEMENT IN GRENADA, WEST INDIES.**
Plymouth Polytechnic (England). Dept. of Geographical Sciences.
J. L. Ternan, A. G. Williams, and K. Solman.
IN: Forest Hydrology and Watershed Management. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication No. 167, 1987. p 409-421, 4 fig, 2 tab, 23 ref.

Descriptors: *Soil water, *Geomorphology, *Rainfall-runoff relationships, *Soil physical properties, *Soil properties, *Soil erosion, Hydraulic properties, Density, Texture, Permeability, Land use, Throughflow, Grasslands, Pastures, Runoff.

Soil texture, bulk density, air capacity and soil permeability at six sites showed considerable variations between sites and within profiles. Differences between sites are related to variations in land use, site position and geomorphic history, and eluviation processes within the profile. Near surface horizons are characterized by low bulk density, high air capacity and high permeability. Subsurface horizons have restricted permeability and low air capacity. Saturated throughflow at shallow depths is considered likely to be the major storm runoff generating process. Measurements in open scrub and grassland sites suggest that conversion from the present tree-based land use to open pasture is likely to have detrimental effects on runoff and soil erosion processes. (See also W90-01432) (Author's abstract)
W90-01470

**DETERMINATION OF HYDROLOGICAL FLOW PATHS AND ASSOCIATED HYDROCHEMISTRY IN FORESTED CATCHMENTS IN CENTRAL SCOTLAND.**
Imperial Coll. of Science and Technology, London (England).
For primary bibliographic entry see Field 5B.
W90-01472

**CLIMATOLOGY OF DRY AND WET PERIODS OVER WESTERN CANADA IN A GENERAL CIRCULATION MODEL.**
Canadian Climate Centre, Downsview (Ontario).
N. E. Sargent.
IN: The Influence of Climate Change and Climatic Variability on the Hydrologic Regime and Water Resources, International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication No. 168, 1987. p 101-108, 3 fig, 1 tab, 7 ref.

Descriptors: *Rainfall variability, *Climatology, *Soil water, *Canada, Temperature, Precipitation, Model studies.

Soil moisture anomalies over the period 1961-1980 at 8 stations in western Canada are estimated by supplying observed temperature and precipitation to a soil moisture model. Temperature and precipitation simulated by a 20 yr run of the Canadian Climate Centre general circulation model over the same area are treated in the same way. These series are normalized and examined from the point of view of dry and wet run lengths and severities. For equal 20 yr lengths of record the GCM has about 11% fewer wet and dry periods than the observations. The range and frequency of severities of dry and wet periods is quite similar between the observations and the GCM. Calculations of the mean square tendency of normalized soil moisture anomaly show it is smaller in the general circulation model data than in observations. This results from a smaller than observed variability in modelled evapotranspirative processes. (See also W90-01537) (Author's abstract)
W90-01546

**UNSATURATED FLOW IN HYDROLOGIC MODELING: THEORY AND PRACTICE.**
Proceedings of the NATO Advanced Research Workshop on Unsaturated Flow in Hydrologic Modelling Theory and Practice, Arles, France, 13-17 June 1988. Kluwer Academic Publishers, Boston. 1989. Series C: Mathematical and Physical Sciences-Vol. 275. Edited by H.J. Morel-Seytoux. 531p.

Descriptors: *Unsaturated flow, *Hydrologic models, *Model studies, *Soil water, Conferences.

Twenty-one papers were presented at the NATO Advanced Research Workshop on Unsaturated Flow in Hydrologic Modeling. These papers are divided into five sections: Perspective and Fundamentals of Unsaturated Flow, Components in the Description of Unsaturated Flow, Parameters Estimation and Numerical Techniques, Treatment of Unsaturated Zone in Hydrologic Models, and Miscellaneous. (See W90-01591 thru W90-01611) (Peters-PTT)
W90-01590

**BACKGROUND CONCEPTS AND PRINCIPLES.**
Louvain Univ. (Belgium).
L. W. De Backer.
IN: Unsaturated Flow in Hydrologic Modeling: Theory and Practice. Kluwer Academic Publishers, Boston. 1989. p 3-25, 6 fig, 52 ref.

Descriptors: *Soil water, *Model studies, *Decision making, *Water storage, *Unsaturated flow, *Hydrologic models, Infiltration, Rainfall-runoff relationships, Evapotranspiration, Groundwater recharge, Aquifers, Soil moisture retention, Soil profiles, Root zone, Statistical analysis, Hysteresis.

Hydrologic modeling is crucial in the decision process for water resources management. It is part of the control step which follows the identification and precedes the optimization that should be made before action is undertaken. Although models are available to simulate separately most of the phenomena which occur in the water cycle, it has not been possible yet to run them simultaneously to estimate the water resources of a given area at a given time. Unsaturated conditions prevail in relationships which would help to integrate precipitation with infiltration, runoff, evapotranspiration, capillary rise and/or groundwater recharge with water storages at the soil surface, in the soil profile, in the subsoil and in the aquifer. It is difficult to account for the time lags within the filling or the emptying because the unsaturated conditions involve hysteresis that further complicates the empirical retention and transfer properties of the soils. Space and time scales have to be respectively adapted to the phenomena involved according to the objectives pursued. Statistical treatment has to be applied to obtain from spatially and/or temporarily distributed data a variable which can be treated analytically or numerically in simpler models. General unsaturated flow equations do not consider plant root activity which accounts for nearly all the water withdrawal from the soil during the growing season. Emphasis has been placed up to now mostly on the modeling of flow. In view of the continuous degradation of the quality of surface and groundwater emphasis should be put now on the modeling of water storage. (See also W90-01590) (Author's abstract)
W90-01591

**MULTIPHASE FLOW IN POROUS MEDIA: DESCRIPTION AT THE PORE AND MACROSCOPIC SCALE.**
Thessaloniki Univ., Salonika (Greece). Lab. of Hydraulics and Hydraulic Works.
J. G. Ganoulis.
IN: Unsaturated Flow in Hydrologic Modeling: Theory and Practice. Kluwer Academic Publishers, Boston. 1989. p 27-52, 22 fig, 25 ref.

Descriptors: *Unsaturated flow, *Multiphase flow, *Model studies, *Porous media, *Soil water, Capillary water, Stochastic process, Interstitial water, Mathematical models, Hydrologic models, Subsurface water.

The fundamental properties of multiphase flows in porous media were studied by considering the movement of menisci at the pore scale. Multiphase processes and properties at the macroscopic scale are characterized by an 'entrapment' of the residual fluid phase. They were analyzed by using capillary models and stochastic theory. An interstitial hydrodynamic model of two immiscible liquid phases was formulated. As an example, the displacement of one liquid by another was studied experimentally and numerically in a model porous medium composed of rod cylinders. The mathematical model of multiphase continua was derived at the macroscopic scale of a porous medium, by using averaging procedures. Present applications in subsurface hydrology and needed developments are discussed. (See also W90-01590) (Author's abstract)
W90-01592

**FLOW OF WATER AND AIR IN SOILS: THEORETICAL AND EXPERIMENTAL ASPECTS.**
Institut de Mecanique de Grenoble, Saint-Martin d'Heres (France).
M. Vauclin.
IN: Unsaturated Flow in Hydrologic Modeling: Theory and Practice. Kluwer Academic Publishers, Boston. 1989. p 53-91, 20 fig, 69 ref.

Descriptors: *Soil water, *Unsaturated flow, *Mathematical analysis, *Multiphase flow, Vadose zone, Numerical analysis.

The physics of water flow in unsaturated soils, viewed as a two-phase problem is discussed. Some quasi-analytical and numerical solutions are reviewed and compared for evaluation, with experimental data. It is shown that the two-phase flow approach is hardly more complicated than the traditional one-phase formulation and it may be more fruitful in many circumstances. Some related problems such as hydrodynamical instabilities, water flow in deformable soils and in heterogeneous soils are also discussed. (See also W90-01590) (Author's abstract)
W90-01593

**INFILTRATION AND PONDING.**
New York State Coll. of Agriculture and Life Sciences, Ithaca. Dept. of Agricultural Engineering.
J.-Y. Parlange, and R. Haverkamp.
IN: Unsaturated Flow in Hydrologic Modeling: Theory and Practice. Kluwer Academic Publishers, Boston. 1989. p 95-126, 11 fig, 8 tab, 57 ref.

Descriptors: *Infiltration, *Ponding, *Soil water, *Model studies, *Mathematical models, Rainfall rate, Mathematical analysis, Soil types, Soil moisture retention.

Existing models describing infiltration and ponding time are described and their limitations discussed in detail. A physically based model which can include numerous effects, such as variable rainfall rates, surface sealing, layering and others, is pre-

sented and is shown, by comparison with reference solutions, to be accurate and reliable for prediction purposes. Such analytical approximations are especially useful to initiate numerical solutions for complex situations and validate numerical schemes. This validation can also be fulfilled by exact solutions in a few restricted situations. (See also W90-01590) (Author's abstract)
W90-01594

**LIQUID MOISTURE REDISTRIBUTION: HYDROLOGIC SIMULATION AND SPATIAL VARIABILITY.**
Texas Univ. at Austin. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2A.
W90-01595

**INTERFLOW.**
Lancaster Univ. (England). Centre for Research on Environmental Systems.
For primary bibliographic entry see Field 2A.
W90-01597

**UNSATURATED FLOW INDUCED BY EVAPORATION AND TRANSPIRATION.**
Princeton Univ., NJ. Dept. of Civil Engineering and Operations Research.
P. C. D. Milly.
IN: Unsaturated Flow in Hydrologic Modeling: Theory and Practice. Kluwer Academic Publishers, Boston. 1989. p 221-240, 30 ref.

Descriptors: *Soil water, *Unsaturated flow, *Evaporation, *Transpiration, *Aeration zone, *Soil-water-plant relationships, *Mathematical analysis, Root zone, Mathematical equations.

Theoretical analyses of water flow in the unsaturated zone induced by evaporation and water uptake by plants are reviewed. The governing equation for such flows is usually taken to be the Richards equation, although there are times when consideration also of vapor or air-flow effects is more realistic. Numerous analytical solutions of various steady and transient boundary-value problems are available for predictions and for verification of more general models. There also exist approximate techniques for linking together in time the analytical descriptions of individual events. Problems of spatial variability can be partially addressed by using some existing analytical results for heterogenous profiles and by performing direct areal integration over variable areas. Problems of water uptake by roots are most easily solved using the quasi-linear analysis and the time-dependent linear analysis. (See also W90-01590) (Author's abstract)
W90-01598

**PREDICTION OF WATER TABLE MOUND DEVELOPMENT AND AQUIFER RECHARGE FROM AN INFILTRATION AREA.**
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2F.
W90-01599

**ESTIMATION OF SOIL WATER RETENTION AND HYDRAULIC PROPERTIES.**
Agricultural Research Service, Beltsville, MD. Hydrology Lab.
W. J. Rawls, and D. L. Brakensiek.
IN: Unsaturated Flow in Hydrologic Modeling: Theory and Practice. Kluwer Academic Publishers, Boston. 1989. p 275-300, 5 fig, 10 tab, 33 ref.

Descriptors: *Soil water, *Hydraulic properties, *Soil moisture retention, *Soil properties, *Infiltration, *Hydraulic conductivity, *Mathematical analysis, Porosity, Soil properties, Regression analysis, Frozen ground, Tillage, Grazing, Range management, Ponding, Infiltration rate, Agricultural hydrology.

Procedures were developed to: (1) estimate parameters for the soil water retention and hydraulic conductivity functions based on other more easily measurable soil properties; (2) estimate infiltration parameters based on soil properties; and (3) test their utility to predict infiltration rates and amounts. Factors affecting soil hydraulic properties include coarse fragments (> 2 mm in size) in the soil, frozen ground and soil crust. All soil management practices primarily influence the hydraulic conductivity parameter. The effects of management practices are incorporated into the infiltration model through the bulk density, soil crust, soil surface cover, canopy cover and macroporosity factors. Tillage, crops and the addition of organic matter are primary agricultural practices that affect the infiltration process. The primary rangeland practices that affect the infiltration process are grazing systems which change the bulk density of the soil due to trampling and remove canopy cover. The predicted mean final infiltration rate and infiltration volume were within one standard deviation of the measured value indicating that the assumptions made and the parameter estimating procedures are acceptable. (See also W90-01590) (Peters-PTT)
W90-01600

**NUMERICAL SIMULATION OF RICHARDS EQUATION: CURRENT APPROACHES AND AN ALTERNATE PERSPECTIVE.**
California Univ., Berkeley. Earth Sciences Div.
T. N. Narasimhan.
IN: Unsaturated Flow in Hydrologic Modeling: Theory and Practice. Kluwer Academic Publishers, Boston. 1989. p 325-341, 5 fig, 12 ref.

Descriptors: *Soil water, *Groundwater movement, *Numerical analysis, *Saturated flow, *Unsaturated flow, Vadose zone, Porous media.

The transient flow of water in saturated-unsaturated media is described by a non-linear parabolic partial differential equation, known as the Richards equation. Numerical solution of Richards equation is often beset with difficulties related to stability, convergence, and verification, particulary when water saturations are low and when material heterogeneities exist. It is suggested that these difficulties arise largely due to the fact that conventional numerical techniques based on finite differences and finite elements do not take into account the nature of the local flow geometry in estimating fluxes. Nor do they recognize that the Darcy-Buckingham equation, in the presence of gravity, heterogeneities or nonuniform flow geometry, is an implicit statement relating flux to the potential distribution between two surfaces of equal potential. For an elemental volume in a transient nonlinear system, capacitance has to be defined in an operational sense, being specifically associated with a chosen location of observation within the elemental volume. In order to compute fluxes accurately, the time-averaging factor has to be made a function of space and of time. Theoretical discussions are provided to demonstrate how these may be synthesized to solve the problem of transient flow in a flow tube of non uniform cross sectional area. (See also W90-01590) (Author's abstract)
W90-01602

**COMPARATIVE EVALUATION OF UNSATURATED FLOW METHODS IN SELECTED USDA SIMULATION MODELS.**
Agricultural Research Service, Fort Collins, CO.
R. E. Smith, and V. A. Ferreira.
IN: Unsaturated Flow in Hydrologic Modeling: Theory and Practice. Kluwer Academic Publishers, Boston. 1989. p 391-412, 10 fig, 3 tab, 15 ref.

Descriptors: *Unsaturated flow, *Root zone, *Model studies, *Comparison studies, *Soil water, *Soil-water-plant relationships, Hydraulic conductivity, Agricultural hydrology, Georgia, Corn, Soil properties.

Simulation of unsaturated flow in the soil root zone is an important part of several plant-soil zone simulation models developed by scientists in the Agricultural Research Service (ARS). Four of these models (Opus, GLEAMS, SPAW, and NTRM) are compared to illustrate strengths and weaknesses of the numerical features of each. Three numerical solutions for Richards' equation and two conceptual linked-storage models are compared using a corn growth season example from a small catchment in Georgia. The linked storage model is shown to be a poor predictor of local flux behavior. One numerical model is a Theta-based transformation, using diffusivity coefficients, which cannot model layered soil behavior without retransformation to water tension at layer boundaries. Other significant problems encountered in the numerical solution models include overshoot due to linearization, biased estimates (e.g., arithmetic mean) of interlayer hydraulic conductivity, and poor time step estimates. Often these problems are not understood due to the narrow focus of model testing or limited previous application. (See also W90-01590) (Author's abstract)
W90-01604

**UNSATURATED COMPONENTS OF SWATCH: A MULTIPROCESS WATERSHED MODEL FOR RUNOFF GENERATION AND ROUTING.**
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
H. J. Morel-Seytous.
IN: Unsaturated Flow in Hydrologic Modeling: Theory and Practice. Kluwer Academic Publishers, Boston. 1989. p 413-433, 10 fig, 8 ref.

Descriptors: *Aeration zone, *Soil water, *Infiltration, *Model studies, Storm runoff, Flow, Infiltration capacity, Portugal, Georgia, Hydrographs, Aquifers, Ponding, Catchment basins, Overland flow, Mathematical analysis, SWATCH model.

The manner in which a watershed model, SWATCH, treats flow and storage in the unsaturated zone is described. The model has the ability to generate flow as overland runoff, interflow and base flow. Two examples of application are provided for one watershed in Portugal and one in the state of Georgia. In both cases verification of the model was quite satisfactory. The ability to predict the recovery in infiltration capacity between intense bursts of rainfall separated by several hours of little or no rain is a valuable feature of the model. For the small watershed in Georgia for which interflow dominates the runoff generation process and without base flow, the two very distinctly shaped hydrographs of overland runoff and interflow, after combination and routing through the creek, described remarkably well the observed hydrograph at the catchment outlet. Because the procedures are almost entirely analytical the cost of running the model is extremely small. (See also W90-01590) (Author's abstract)
W90-01605

**SPATIALLY DISTRIBUTED MODELLING: CONCEPTUAL APPROACH, COUPLING SURFACE WATER AND GROUNDWATER.**
Ecole Nationale Superieure des Mines de Paris, Fontainebleau (France). Centre d'Information Geologique.
For primary bibliographic entry see Field 7C.
W90-01606

**INFLUENCE OF SPATIAL VARIABILITY OF SATURATED HYDRAULIC CONDUCTIVITY ON THE INFILTRATION PROCESS.**
Technical Univ. of Lisbon (Portugal). High Inst. of Agronomy.
P. Matias, F. N. Correia, and L. S. Pereira.
IN: Unsaturated Flow in Hydrologic Modeling: Theory and Practice. Kluwer Academic Publishers, Boston. 1989. p 455-467, 9 fig, 3 tab, 25 ref.

Descriptors: *Groundwater movement, *Hydraulic conductivity, *Model studies, *Infiltration, *Soil water, Ponding, Infiltration rate, Rainfall-runoff relationships, OMEGA model, Rainfall intensity.

Using a distributed rainfall-runoff model, OMEGA, the influence of the spatial variability of the saturated hydraulic conductivity on the infiltration process have been simulated. The two-phase infiltration theory of Morel-Seytoux is used in the model and the analysis was done about the probabilistic distributions of infiltration rates and ponding times. Characterizing the spatial variabili-

ty of the saturated hydraulic conductivity (K sub s) by a three parameter log-normal distribution F(K sub s), six sets of 100 values of K sub s have been randomly generated, corresponding to 100 subsections of the watershed; all sets have the same mean but different standard deviations and skewness coefficients. The infiltration process was then simulated for three different constant intensity rainfall events. Although the limitation of the simulations are important, some conclusions have been reached: (1) the variation of the coefficient of variation has much more influence on the variability of infiltration rates and ponding times than the variation of the skewness coefficient; (2) for the same mean value, higher coefficients of variation of K sub s, correspond to reduced infiltration rates and lower ponding times, and this effect grows when the rainfall rates decrease; (3) the probability distributions of infiltration rates tend to F(K sub s) with time. (See also W90-01590) (Author's abstract)
W90-01607

**ANALYTICAL STEADY-STATE SOLUTION TO ONE-DIMENSIONAL UNSATURATED WATER FLOW IN LAYERED SOILS.**
Minnesota Univ., St. Paul. Dept. of Agricultural Engineering.
I. L. Lopez-Bakovic, and J. L. Nieber.
IN: Unsaturated Flow in Hydrologic Modeling: Theory and Practice. Kluwer Academic Publishers, Boston. 1989. p 471-480, 8 fig.

Descriptors: *Hydraulic conductivity, *Unsaturated flow, *Model studies, *Soil water, Water table, Mathematical analysis, Soil profiles.

A one-dimensional solution of darcian flow in the unsaturated zone for a layered soil profile is given by assuming an exponential relationship for hydraulic conductivity. Expressions to solve for matric potential, soil water content and hydraulic conductivity are derived as a function of elevation above a water table. The results of an application example with two layers are plotted for these three soil properties. (See also W90-01590) (Author's abstract)
W90-01608

**CONSTANT HEAD PERCOLATION TEST-IMPROVED EQUIPMENT AND POSSIBILITIES OF ASSESSING THE SATURATED HYDRAULIC CONDUCTIVITY.**
Norges Landbrukshoegskole, Aas. Inst. for Georesources and Pollution Research.
P. D. Jenssen.
IN: Unsaturated Flow in Hydrologic Modeling: Theory and Practice. Kluwer Academic Publishers, Boston. 1989. p 481-488, 3 fig, 18 ref.

Descriptors: *Hydraulic conductivity, *Soil water, *Percolation tests, *Instrumentation, *Measuring instruments, *Field tests, Water table, Capillary water, Tensiometers.

The constant head percolation test is a simple field method that may be used to assess the saturated hydraulic conductivity above the water table. Improved measuring equipment has been developed. The equipment includes a porous plastic liner that preserves both the borehole geometry and the soil structure when measuring saturated hydraulic conductivity. In capillary soils the saturated hydraulic conductivity calculated from measurement with the constant head percolation test is greatly overestimated if capillarity is not taken into account. A simple analytical solution which accounts for capillarity through tensiometer measurements is presented. This and other solutions were applied to field measurements. The field measurements indicate that analytical solutions exist by which the saturated hydraulic conductivity can be estimated with sufficient accuracy for engineering purposes. (See also W90-01590) (Author's abstract)
W90-01609

**MOBILITY OF RESIDUAL PHASE ORGANICS IN THE VADOSE ZONE.**
Waterloo Univ. (Ontario). Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W90-01610

**MOVEMENT OF WATER IN SWELLING CLAYS.**
Demokritos Univ. of Thrace, Komotini (Greece).
T. K. Karalis.
IN: Unsaturated Flow in Hydrologic Modeling: Theory and Practice. Kluwer Academic Publishers, Boston. 1989. p 499-508, 6 fig, 10 ref.

Descriptors: *Unsaturated flow, *Soil water, *Clays, *Soil water, *Mathematical analysis, Infiltration, Wetting.

A method is suggested by which an approximate hydration-distance curve in the non-steady state can be obtained for the non-saturated swelling clays. Some insight into the nature of the advancing boundary is provided, and the significance of the diffusion coefficient deduced from the rate of advance of such a boundary is considered. The theory shows that the swelling rate depends on the permeability and swelling pressure at the instantaneous average hydration. The analysis demonstrates the possibility of describing the movement of water through swelling non-saturated clays with a parabolic swelling equation lacking any arbitrary parameters. (See also W90-01590) (Peters-PTT)
W90-01611

**EFFECTS OF URBAN SOIL SEALING AND SOIL MODIFICATION ON THE GROUND- AND SOIL-WATER BUDGET AND THEIR MANAGEMENT BY PLANNING.**
Geologisches Landesamt Hamburg (Germany, F.R.).
For primary bibliographic entry see Field 4C.
W90-01666

**ION BALANCE IN FOREST ECOSYSTEMS (IONBALANCE I SKOV-KOSYSTEMER).**
Miljoestyrelsen, Roskilde (Denmark). Luftforureningslaboratoriet.
For primary bibliographic entry see Field 2K.
W90-01739

**NUMERICAL ANALYSIS OF WATER AND SOLUTE MOVEMENT IN REALISTICALLY COMPLEX SOIL PROFILES.**
Commonwealth Scientific and Industrial Research Organization, Wembley (Australia). Div. of Groundwater Research.
A. A. Curtis.
IN: Irrigation and Water Allocation. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication no. 169, 1987. p 59-71. 4 fig, 2 tab, 12 ref.

Descriptors: *Numerical analysis, *Soil water, *Finite difference methods, *Solute transport, *Infiltration, Model studies, Hydraulic conductivity, Leaching, Hysteresis, Simulation analysis, Solute transport, Irrigation.

A method is presented for the numerical analysis of unsaturated water and solute movement in heterogeneous soil profiles of a realistically complex nature. Such a method is required, since soil profiles are frequently gradational and soil hydrological properties vary with depth. The analysis uses a one-dimensional finite difference soil water flow model which includes a technique for combining the concepts of scale heterogeneity with an interpolative soil water hysteresis model. An explicit finite difference solute movement subroutine is incorporated to describe the transport of non-reactive solutes. The model is used to study the dynamics of water and solute movement in soil profiles consisting of sand and loam sequences and over which the saturated hydraulic conductivity varies by three orders of magnitude. Results are presented for infiltration and redistribution following the application of a constant flux of relatively low solute concentration to leach a dry soil profile. (See also W90-01828) (Author's abstract)
W90-01834

**NUMERICAL ANALYSIS OF THE EFFECT OF PERIODICITY ON SOLUTE MOVEMENT DURING INTERMITTENT LEACHING.**
New South Wales Univ., Kensington (Australia). School of Civil Engineering.
K. K. Watson, and M. J. Jones.
IN: Irrigation and Water Allocation. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication no. 169, 1987. p 81-90. 8 fig, 12 ref.

Descriptors: *Leaching, *Infiltration, *Soil water, *Solute transport, *Numerical analysis, *Hysteresis, Leaching, Model studies, Loam, Computer models.

The effect of varying the time pattern of the infiltration-redistribution events on intermittent leaching is studied using computer-based numerical analyses of the appropriate differential equations for water and solute movement. The soil-water hysteresis model used is an interpolative model that defines secondary and higher order scanning curves from the primary wetting and draining scanning curves. The relevant soil-water characteristic data for a sandy loam material is presented. For this material, four different infiltration event times are analyzed and the resultant solute mass profiles compared. This comparison indicates that the duration of the infiltration event is the significant factor in determining the position, shape and inter-peak spacing of the solute mass profiles. (See also W90-01828) (Author's abstract)
W90-01836

**EFFECTS OF IRRIGATION ON THE CHEMICAL BALANCE IN THE ECOLOGICAL ENVIRONMENT OF WATER AND SOIL.**
Changchun Coll. of Geology (China). Station of Environmental Hydrogeology.
For primary bibliographic entry see Field 3F.
W90-01839

**OPERATIONAL AIRBORNE MEASUREMENTS OF SNOW WATER EQUIVALENT AND SOIL MOISTURE USING TERRESTRIAL GAMMA RADIATION IN THE UNITED STATES.**
National Weather Service, Minneapolis, MN. Office of Hydrology.
For primary bibliographic entry see Field 2C.
W90-01869

## 2H. Lakes

**DEFINING REGIONAL POPULATIONS OF LAKES FOR THE ASSESSMENT OF SURFACE WATER QUALITY.**
NSI Technology Services Corp., Corvallis, OR.
C. B. Johnson, T. J. Sullivan, and D. J. Blick.
Water Resources Bulletin WARBAQ, Vol. 25, No. 3, p 565-572, June 1989. 4 fig, 2 tab, 12 ref. EPA Contract No. 68-C8-0006.

Descriptors: *Surface water, *Water quality, *Lake morphometry, *Topographic mapping, Lakes.

Topographic maps are commonly used to define populations of lakes in regional surveys of surface water quality. To illustrate the effect of different maps on that process, the lakes represented on the 1:250,000 scale maps used for the Northeast Region of the Eastern Lake Survey-Phase I (ELS-I) were compared to the lakes on a sample of large scale maps (1:240,000 or 1:62,500). Lake areas at or near the lower limit of representation delimit 'smallest-lake' values for the compared 1:250,000 scale maps. The regional median for these values was 4.5 hectares (ha) and ranged from 0.6 to 24.8 ha. Lake representation is influenced by cartographic limitations such as map scale, age, and complexity as well as the inherent variability of water bodies (e.g., water level fluctuations or the creation of reservoirs, beaver impoundments, and oxbows). The total number of lakes on large-scale maps increased markedly as lake area decreased. Approximately 15,700 of the estimated 29,000 lakes

in the EPA's Northeast Region were 1 to 4 ha in area. Because maps affect the size distribution of lakes included in a regional survey and because lake areas are thought to modify lake chemistry, maps ultimately affect the estimates of regional surface water quality. (Author's abstract)
W90-00971

**CHANGES IN STRATIFICATION IN ONONDAGA LAKE, NEW YORK.**
Massachusetts Inst. of Tech., Cambridge. Ralph M. Parsons Lab.
E. M. Owens, and S. W. Effler.
Water Resources Bulletin WARBAQ, Vol. 25, No. 3, p 587-597, June 1989. 6 fig, 2 tab.

Descriptors: *New York, *Lake restoration, *Lakes, *Chemical stratification, *Turnover time, *Onondaga Lake, Model studies, Water quality, Anoxia, Stratification.

The calibration of a mixed-layer stratification model to the complex stratification region on Onondaga Lake is documented. The short-and long-term impacts of the closure of an adjoining alkali plant on the stratification regime of Onondaga Lake are evaluated with this model from the perspective of natural variations associated with meteorological variability. Chemical stratification prevailed in the lake during the operation of the facility as a result of its discharge of ionic waste. A predicted likely short-term impact of the closure, that was subsequently observed, was the failure of the lake to turn over in the spring immediately following the closure. Spring turnover did not occur regularly in the future. Other projected changes in average stratification conditions include: (1) a 45% shorter period of stratification, (2) a 3m deeper upper mixed layer, and (3) a 30% lower maximum density gradient. Substantial variability in the stratification is predicted as a result of meteorological variability, indicating that comparison of characteristics for individual years during and after the operation of the facility could be misleading. the changes in the stratifications regime are expected to affect water quality. In particular, certain features of the oxygen resources of the hypolimnion are expected to improve (e.g., delayed onset of anoxia). (Author's abstract)
W90-00974

**ENERGY-FLOW RESPONSE MODELS FOR EVALUATION OF ALTERED RIPARIAN VEGETATION IN THREE SOUTHEAST ALASKAN STREAMS.**
Idaho Univ., Moscow. Dept. of Plant, Soil and Entomological Sciences.
W. F. A. Duncan, M. A. Brusven, and T. C. Bjornn.
Water Research WATRAG, Vol. 23, No. 8, p 965-974, August 1989. 7 fig, 6 tab, 26 ref. Cooperative agreement PNW-82-162.

Descriptors: *Alaska, *Flood plains, *Riparian vegetation, *Productivity, Fish populations, Benthic fauna, Nutrients, Energy transfer, Model studies.

First approximation production-response models to riparian vegetation alteration for low-order southeast Alaskan streams are presented. The models reflect negative and positive production responses with respect to estimated maximum production values (kcal). Using the models we predict the response of autochthonous and allochthonous production, benthic and terrestrial macroinvertebrate production, and potential salmonid tissue elaboration to variation in riparian cover, riparian composition and stream nutrients. Higher amounts of net usable allochthonous input are predicted with increasing riparian cover and percentage deciduous composition. Autochthonous production and net usable allochthonous production form the primary energy base of the stream ecosystem and are linked via energy transfer coefficients to higher trophic levels, e.g. benthic macroinvertebrate (BMI) production. Like the energy transfer coefficients derived for autochthonous and allochthonous production, the terrestrial invertebrate and salmonid production estimates are first approximations and require validation. These models provide resource managers with criteria to assess probable consequences of different riparian management strategies on fisheries resources in S.E. Alaska. (Author's abstract)
W90-00994

**STOCHASTIC PHOSPHOROUS MODEL FOR ONONDAGA LAKE.**
Michigan Univ., Ann Arbor. Dept. of Civil Engineering.
R. P. Canale, and S. W. Effler.
Water Research WATRAG, Vol. 23, No. 8, p 1009-1016, August 1989. 10 fig, 20 ref.

Descriptors: *Limnology, *Path of pollutants, *Phosphorus, *Lakes, *Water quality management, *New York, *Cycling nutrients, *Monte Carlo method, Model studies, Simulation analysis.

A probabilistic phosphorus model that utilizes the Monte Carlo technique was developed and applied to address water quality management issues for Onondaga Lake, NY. Several analyses were conducted to support model development: (1) evaluation of the loading and concentration of phosphorus in the lake; (2) determination of the natural variability of flow and non-point loading to the lake; (3) validation of a deterministic total phosphorus model for the lake; and (4) examination of the uncertainty associated with the phosphorus model using Monte Carlo techniques. Simulations with the probabilistic model have been used to evaluate the significance of year-to-year changes in rainfall, the level and variability of point source, operation at METRO and uncertainty in the model coefficients. The results indicate that substantial reductions in loading from point sources and some control of non-point sources are necessary to achieve distinct improvements in water quality in the lake. Furthermore, significant year-to-year differences in phosphorus concentration are expected in the lake in response to natural variations in rainfall and runoff. (Author's abstract)
W90-01000

**FEDERAL REGULATION OF AGRICULTURAL DRAINAGE ACTIVITY IN PRAIRIE POTHOLES: THE EFFECT OF SECTION 404 OF THE CLEAN WATER ACT AND THE SWAMPBUSTER PROVISIONS OF THE 1985 FARM BILL.**
For primary bibliographic entry see Field 5G.
W90-01008

**EFFECTS OF SALINITY, NITROGEN, AND POPULATION DENSITY ON THE SURVIVAL, GROWTH, AND REPRODUCTION OF ATRIPLEX TRIANGULARIS (CHENOPODIACEAE).**
Ohio Univ., Athens. Dept. of Botany.
D. R. Drake, and I. A. Ungar.
American Journal of Botany AJBOAA, Vol. 76, No. 8, p 1125-1135, August 1989. 5 fig, 6 tab, 43 ref.

Descriptors: *Wetlands, *Aquatic plants, *Halophytes, *Salinity, *Nitrogen, *Population density, *Plant growth, *Salt marshes, Atriplex, Biomass, Saline ponds, Ohio.

Populations of Atriplex triangularis were grown under laboratory conditions in a growth chamber and manipulated in an inland Ohio saline pond in order to examine the relative effects of salinity, N fertilization, and population density on growth, reproduction, and survival. For laboratory plants, N fertilization was the most important variable, with biomass and reproductive effort being greatest at the high N level. As salinity increased, biomass decreased only in plants not limited by N. Increasing density caused biomass per plant to decrease at both high and low N levels. For field plants, density was the most important variable, with biomass per plant and survival both decreasing as density increased. As density increased, size inequality among individuals increased but biomass per unit area and individual reproductive effort remained relatively constant. N fertilization slightly enhanced survival, but did not affect biomass. It is suggested that density-dependent processes may be significant even in relatively harsh physical environments. (Author's abstract)
W90-01010

**MORPHOLOGICAL VARIATION OF ELLIPTIO COMPLANATA (BIVALVIA: UNIONIDAE) IN DIFFERING SEDIMENTS OF SOFT-WATER LAKES EXPOSED TO ACIDIC DEPOSITION.**
University of Western Ontario, London. Dept. of Zoology.
For primary bibliographic entry see Field 5C.
W90-01012

**ENVIRONMENTAL FACTORS FAVOURING THE FORMATION OF MICROCYSTIS AERUGINOSA HYPERSCUMS IN A HYPERTROPHIC LAKE.**
National Inst. for Water Research, Pretoria (South Africa).
T. Zohary, and C. M. Breen.
Hydrobiologia HYDRB8, Vol. 178, No. 3, p 179-192, Jul 17 1989. 10 fig, 2 tab, 42 ref.

Descriptors: *Limnology, *Eutrophic lakes, *Scum, *Microcystis, Population dynamics, Seasonal variation, Wind, Hartbeespoort Dam, South Africa, Hyperscums.

Hyperscums are crusted buoyant mats of densely packed cyanobacteria, often decimeters thick, that persist for periods of weeks to months at the same site. In Hartbeespoort Dam, a hypertrophic lake in South Africa, hyperscum of the cyanobacterium Microcystis aeruginosa that cover more than a hectare and contain up to 2 tons of chlorophyll a typically form in winter and persist for 2-3 months. Reynolds & Walsby have postulated that cyanobacterial bloom formation depends on the coincidence of three preconditions: a pre-existing population, a significant proportion of the organisms having positive buoyancy, and turbulent mixing that is too weak to overcome the tendency of the cells to float. This model of bloom formation is evaluated in the context of hyperscum, based on a case study from Hartbeespoort Dam. The occurrence of hyperscum and the dynamics of their formation and breakdown are examined in relation to diurnal and seasonal changes in the wind regime and in relation to the population dynamics and buoyancy of Microcystis. Reynolds and Walsby's preconditions are shown to be essential but not sufficient to explain hyperscum formation. The additional preconditions are prolonged low speed wind regime, suitable lake morphometry, large cyanobacterial standing crops, and high isolation. The rare co-occurrence of these conditions make hyperscum an uncommon phenomenon, but with increasing eutrophication worldwide the frequency and distribution of hyperscum occurrence are likely to increase. (Author's abstract)
W90-01014

**INFERRING PH FROM DIATOMS: A COMPARISON OF OLD AND NEW CALIBRATION METHODS.**
Instituut TNO voor Wiskunde, Informatieverwerking en Statistiek, Wageningen (Netherlands).
For primary bibliographic entry see Field 5A.
W90-01015

**IMPACT OF HIGHWAY CONSTRUCTION ON LEAF PROCESSING IN AQUATIC HABITATS OF EASTERN TENNESSEE.**
Tennessee Technological Univ., Cookeville. Dept. of Biology.
For primary bibliographic entry see Field 4C.
W90-01016

**HYDROCHEMICAL EVOLUTION OF REGIONAL GROUNDWATERS TO PLAYA BRINES IN CENTRAL AUSTRALIA.**
Bureau of Mineral Resources, Geology and Geophysics, Canberra (Australia).
J. Jankowski, and G. Jacobson.
Journal of Hydrology JHYDA7, Vol. 108, No. 1-4, p 123-173, Jun 1989. 21 fig, 10 tab, 65 ref.

Descriptors: *Geochemistry, *Groundwater, *Playas, *Brines, *Water chemistry, Salinity, Bicarbonates, Chlorides, Sulfates, Sodium, Potassium, Magnesium, Silicates, Alkalinity, Model studies, Australia.

A large-scale groundwater system in central Australia discharges to a chain of playas. Recharge in calcrete and fractured rock aquifers gives rise to relatively low-salinity HCO3-Cl-SO4 groundwaters, which evolve through regional saline groundwaters to highly saline playa brines. The hydrochemical evolution of the groundwaters follows the anionic sequence HCO3-Cl-SO4 to Cl-HCO3-SO4 to Cl-SO4-HCO3 to Cl-SO4-Cl. With increasing salinity there is a relative increase in Na, K, Mg, Cl and SO4; however, there is a relative decrease in HCO3, Ca and SiO2 owing to the precipitation of carbonate, sulfate and silicate minerals, and the resultant brines are depleted in these ions. Significant variation in the composition of playa brines is a result of complex processes of solution, evaporative concentration, precipitation and mineralogical change, including dolomitization. Thermodynamic calculations have enabled a general model to be developed for these evolutionary processes in groundwaters up to the stage of halite saturation. At an early stage the regional groundwaters are saturated with respect to the carbonate minerals, dolomite first, then calcite. With increasing salinity, sulfate minerals begin to precipitate: saturation with respect to gypsum is attained at a chlorinity of 19 per mil, and saturation with respect to anhydrite is attained at 122 per mil. The playa brines attain saturation with respect to halite at a chlorinity of 144 per mil. Solute budgets based on a chloride concentration factor show that final playa brines are 178 times more concentrated than recharge groundwaters, and confirm the virtually complete loss of HCO3, Ca and SiO2 through precipitation. Most Australian playas have brines of the Cl-Na type with SO4 and Mg also important. The Hardie-Eugster model for brine evolution and mineral precipitation sequences has therefore been modified and extended. Three pathways are defined, following calcite precipitation, on the basis of the ratio of molar Ca to alkalinity; these pathways lead to saline waters with different compositions. Subsequent evolution of the brines depends on the ratios between molar SO4, Mg, Ca and alkalinity. (Author's abstract)
W90-01023

**GEOSTATISTICAL TOOL FOR DROUGHT MANAGEMENT.**
Georgia Inst. of Tech., Atlanta. School of Civil Engineering.
For primary bibliographic entry see Field 2E.
W90-01029

**UNDERWATER LIGHT CONDITIONS AS A KEY FOR PHYTOPLANKTON PHOTOSYNTHETIC EFFICIENCY I. RIO TERCERO RESERVOIR CORDOBA, ARGENTINA. (CONDICIONES DE LUZ SUBACUATICA COMO FACTORES DETERMINANTES DE LA EFICIENCIA FOTOSINTETICA FITOPLANCTONICA. 25P. I. RIO TERCERO RESERVOIR, CORDOBA, ARGENTINA. EMBALSE DE RIO TERCERO (CORDOBA, ARGENTINA)).**
Consejo Nacional de Investigaciones Cientificas y Tecnicas, Buenos Aires (Argentina). Inst. de Limnologia.
For primary bibliographic entry see Field 5C.
W90-01053

**LIMNOLOGY OF THE MONTCORTES LAKE (1978-79 CYCLE) (LIMNOLOGIA DEL LAGO DE MONTCORES (CICLO 1978-79) (PALLARS JUSSA, LLEIDA)).**
Passatge Rovira, 17 baixos, 08005 Barcelona, Spain.
X. Modamio, V. Peres, and F. Samarra.
Oecologia Aquatica, Vol. 9, p 9-17, December 1988. 7 fig, 10 ref. English summary.

Descriptors: *Lakes, *Limnology, *Zooplankton, *Phytoplankton, *Plankton, Transparency, Temperature, Oxygen, Nutrients, Sulfides, Chlorophyll, Alkalinity, Hydrogen ion concentration, Daphnia, Cyclotella, Montcortes Lake, Spain, Seasonal variation, Chemical properties.

Limnology of Montcortes Lake (Pallars Jusa, Lleida, Spain) was studied during the annual cycle of 1978-79. The following parameters were evaluated: temperature, light, transparency, oxygen, nutrients, sulfides, pH, alkalinity, chlorophyll, phytoplankton and zooplankton. During the studied cycle, the lake was homogenized in winter and fall and stratified in spring and summer. During the summer there was a clear thermocline at 10 m depth, but an anaerobic hypolimnion was not found, as was previously reported. Phytoplankton was composed essentially of Cyclotella (Oscillatoria rubescens, Peridnium sp. and Ceratium hirundinella). During spring there was a great bloom of Cyclotella in surface waters which depleted dissolved silicate. A very dense population of Oscillatoria rubescens was located below the thermocline Zooplankton was composed of Daphnia longispina, Ceriodaphnia, Bosmina longirostris, Keratella quadrata and Polyarthra vulgaris. The greatest population of D. longispina was found from April to June in near-surface waters. B. longirostris had its maximum in December-January and June-July. (Author's abstract)
W90-01054

**COMPOSITION AND SEASONAL VARIATIONS OF THE CHLOROPHYLLIC PIGMENT IN PHYTOBENTHOS ASSEMBLAGES OF THE TER RIVER OVER A NINE-MONTH PERIOD (COMPOSICION Y CICLO DE PIGMENTOS CLOROFILICOS EN LAS POBLACIONES DEL FITOBENTOS DEL RIO TER DURANTE UN PERIODO DE NUEVE MESES).**
Barcelona Univ. (Spain). Dept. de Ecologia.
S. Sabater.
Oecologia Aquatica, Vol. 9, p 61-75, December 1988. 10 fig, 4 tab, 45 ref. English summary.

Descriptors: *Chlorophyll a, *Ter River, *Pigments, Benthos, Seasonal variation, Spain, Regression analysis, Salinity, Nutrients, Headwaters.

Dynamics of pigments were studied in eighteen sites in the Ter river basin during a nine-month period. Clorophyll a (Chl a) has been revealed as the most abundant form of chlorophyll pigments through an HPLC analysis. Highest Chl a concentrations were observed downstream of the reservoirs (around 300 mg/sq m) and in some calcareous tributaries. Minimal values were recorded in headwaters (20-50 mg/sq m) and in some siliceous mountain tributaries. Spring and summer were the periods when the Chl a concentration reached the highest values in the basin, with lower ones in winter. The phaeopigment concentration was important during summer and winter, but was near to zero during spring, suggesting Chl a was completely active at this time. The D430/D665 ratio remained constant around 2. Correlation analysis and PCA carried out between physico-chemical variables and chl a values suggested a clear arrangement with salinity and nutrient concentration. In fact, an stepwise regression analysis carried out with the five first principal components of PCA, pointed out that the pigment concentration is a result of the linear combination of river salinity (space) and water flow (time). The sites of the middle stretch in the axis of the river, seem to be the most favored by this combination, mainly during spring and summer. (Author's abstract)
W90-01056

**GEOCHEMICAL FEATURES OF THE TER RIVER WATERSHED (NE SPAIN).**
Barcelona Univ. (Spain). Dept. de Ecologia.
For primary bibliographic entry see Field 2K.
W90-01057

**PHYSICAL PROPERTIES OF THE ENVIRONMENT RELEVANT TO THE PELAGIC ECOSYSTEM OF A DEEP HIGH-MOUNTAIN LAKE (ESTANY REDO, CENTRAL PYRENEES).**
Barcelona Univ. (Spain). Dept. de Ecologia.
J. Catalan.
Oecologia Aquatica, Vol. 9, p 89-123, December 1989. 23 fig, 8 tab, 62 ref.

Descriptors: *Limnology, *Lakes, *Sediments, *Mountain lakes, Temperature, Light, Lake morphology, Mixing, Pyrenees, Spain, Physical properties, Turbulent flow.

From an ecological approach the physical environment of lakes can be summarized by four components: temperature, light, turbulence, and the morphology of the basin and its watershed. The variability through an annual cycle of these components of the physical environment of the Estany Redo is described and their implications for the dynamics of its biota are examined. The ratio between catchment area size (155 sq hm) and lake volume (7.75 cu hm) is extremely small. The value of relative depth is extraordinarily high (13%). Both aspects contribute to the oligotrophy of the lake. Because of the hypsographic configuration of the Lake Redo there is a sediment focusing above 40 m and between 15 and 25 m. Production peaks should be linked to the interaction of mixing layer with these sediment-rich bottoms. Other implications of the temperature, the light and the mixing time scales in the lake biological dynamics are also examined. (Author's abstract)
W90-01058

**TIME-SPACE HETEROGENEITY IN THE SEDIMENTS OF THE RICE FIELDS FROM THE EBRO DELTA (NE SPAIN) (HETEROGENEIDAD ESPACIOTEMPORAL DEL SEDIMENTO DE LOS ARROZALES DEL DELTA DEL EBRO (NE DE ESPANA)).**
Barcelona Univ. (Spain). Dept. de Ecologia.
E. Fores, and S. Gonzalez.
Oecologia Aquatica, Vol. 9, p 125-135, December 1989. 3 fig, 8 tab, 25 ref. English summary.

Descriptors: *Phosphorus, *Rice, *Wetlands, *Sediments, Organic matter, Nutrients, Denitrification.

Nutrients and other physical and chemical parameters were studied in rice field sediments of the Ebro Delta in order to describe their changes during the growing period. C, N, P, Ca, Al, Mg, organic matter and water content were analyzed. Also granulometric analysis were performed. A comparison of sediment nutrient contents and particle size in four rice fields was made in order to know which are the differences between ricepath in the Ebro Delta. The results show that rice growth and denitrification seem to play an important role in the variation of nitrogen concentration with time. Changes in the physical and chemical characteristics of the inundation water during the growing period explained the variation of phosphorus concentration in the last phases of the cultivation period. From the studied parameters, organic matter content and texture of sediments were the best parameters to explain the differences between rice fields in the Ebro Delta. (Author's abstract)
W90-01059

**HEMATOLOGICAL ASSESSMENT OF TEMPERATURE AND OXYGEN STRESS IN A RESERVOIR POPULATION OF STRIPED BASS (MORONE SAXATILIS).**
Oklahoma State Univ., Stillwater. Dept. of Zoology.
R. L. Lochmiller, J. D. Weichman, and A. V. Zale.
Comparative Biochemistry and Physiology (A) CBPAB5, Vol. 93, No. 3, p 535-541, 1989. 4 fig, 1 tab, 25 ref.

Descriptors: *Limnology, *Fish physiology, *Reservoir fisheries, *Temperature effects, *Oxygen deficit, Seasonal variation, Bass, Dissolved oxygen, Hematology.

Hematological characteristics of a reservoir population of adult striped base were monitored for 15 months to evaluate their responses to seasonal changes in water temperature and dissolved oxygen concentration. All fish were caught and removed from gill nets within 1 hr. All hematological parameters measured varied significantly

with month of capture. In general, red blood cell counts, hematocrits, hemoglobin concentrations, and mean corpuscular hemoglobin values were highest in autumn and winter and lowest in summer. Most hematological parameters measured were significantly correlated with both water temperature and dissolved oxygen concentration at the site of capture. The hematological changes observed in this study suggest that fish were stressed by high water temperatures and low concentrations of dissolved oxygen in summer 1987, and that this stress probably resulted in secondary nutritional problems and extensive mortality. (Author's abstract)
W90-01064

**SEASONAL OCCURRENCE OF CONIDIA OF AQUATIC HYPHOMYCETES (FUNGI) IN LEES CREEK, AUSTRALIAN CAPITAL TERRITORY.**
Canberra Coll. of Advanced Education, Belconnen (Australia). Water Research Centre.
K. Thomas, G. A. Chilvers, and R. H. Norris.
Australian Journal of Marine and Freshwater Research AJMFA4, Vol. 40, No. 1, p 11-23, 1989. 4 fig, 4 tab, 30 ref.

Descriptors: *Fungi, *Litter, *Streams, *Australia, *Seasonal variation, Temperature effects, Rainfall, Conidia, Analysis of variance.

The aquatic hyphomycete spora of an upland stream (Lees Creek) were sampled twice monthly by membrane filtration at two sites, the upstream one with native riparian vegetation and the downstream one with exotic pines. Physicochemical properties of the water were measured at each sampling. Conidia of 43 species were collected, of which 18 are undescribed and most species occurred at both sites. The peak concentrations of conidia occurred in late summer to early autumn and minimum concentration in winter. This contrasts with the autumn-winter maximum and summer minimum concentrations recorded for tree-lined streams of the Northern Hemisphere. These differences correspond with differences in seasonality of litter fall in the Northern Hemisphere compared with Australia. Analysis of variance showed significant differences between the two sites for concentrations of conidia of individual species and of total conidia. The magnitude of these differences was related to the time of sampling. Using multiple linear regression analysis, the occurrences of conidia detected at the up-stream site were best explained by water temperature; down-stream, rainfall and water temperature together explained most variance. (Author's abstract)
W90-01066

**LIMNOLOGY OF FOUR GROUNDWATER-FED SALINE LAKES IN SOUTH-WESTERN AUSTRALIA.**
Western Australia Univ., Nedlands. Dept. of Zoology.
C. M. Burke, and B. Knott.
Australian Journal of Marine and Freshwater Research AJMFA4, Vol. 40, No. 1, p 55-68, 1989. 9 fig, 3 tab, 24 ref.

Descriptors: *Limnology, *Saline lakes, *Groundwater basins, *Australia, *Sinks, Salinity, Temperature, Dissolved oxygen, Hydrogen ion concentration, Alkalinity, Shallow water, Supersaturation, Benthos, Sediments, Photosynthesis.

Salinity, temperature, dissolved oxygen (DO), pH and total alkalinity (TA) were measured in four saline lakes of Yalgorup National Park, Western Australia, primarily over an 18-month period, July 1985 to January 1987, but also during 1987 and in 1988. These lakes are shallow (< 3 m) groundwater sinks with no surface drainage. Rainfall and hence groundwater inflow to the lakes was highly seasonal and occurred mainly between May and October. Lakes Hayward, North Newnham and South Newnham were consistently hypersaline (e.g. Hayward 61-214 g/L) and Hayward and North Newnham were stratified from autumn to early summer. The bottom layer of water in Hayard was usually super-saturated (to 430%) with respect to DO, because of the photosynthetic activity of the benthic microbial communities (BMC). South Newnham did not stratify in 1985, but did so briefly in 1987 after a BMC developed. The salinity of Lake Pollard varied from 19 to 51 g/ L and the lake did not stratify at all. During spring, extensive growth of the charophyte Lamprothamnium papulosum across the sediments in Lake Pollard increased DO (from 0.26 to 0.075 meq/L/unit salinity);later removal of the L. papulosum by swans reduced DO to 50% saturation and pH to 7.5, and increased specific TA to 0.15 meq/L/unit salinity. It is apparent that the processes controlling Hayward, North Newnham and South Newnham are similar and are based on the activities of the BMC. South Newnham is at an earlier stage of evolution. However, Pollard is controlled primarily by L. papulosum growth and its subsequent removal by swans; this indicates a different evolutionary path for this lake. (Author's abstract)
W90-01069

**OBSERVED PARAMETERS FOR TURBIDITY-CURRENT FLOW IN CHANNELS, RESERVE FAN, LAKE SUPERIOR.**
National Bureau of Oceanography, Qingdao (China). First Inst. of Oceanography.
For primary bibliographic entry see Field 2J.
W90-01100

**COUPLING OF THE SEASONAL PATTERNS OF BACTERIOPLANKTON AND PHYTOPLANKTON IN A EUTROPHIC LAKE.**
Clermont-Ferrand-2 Univ., Aubiere (France). Lab. d'Hydrobiologie.
O. Marvalin, L. Aleya, H. J. Hartmann, and S. Lazarek.
Canadian Journal of Microbiology CJMIAZ, Vol. 35, No. 7, p 706-712, July 1989. 5 fig, 28 ref.

Descriptors: *Eutrophic lakes, *Seasonal variation, *Phytoplankton, *Photosynthetic bacteria, Microscopy, Gomphosphaeria, Sphaerocystis, Bacteria, Biomass.

Developments of bacterial and phytoplankton biomass were assessed during an annual sampling cycle in a eutrophic lake (Lake Aydat, France). Bacterial abundance, estimated by epifluorescence microscopy counting, varied from 0.61 to 12.72 times 10 to the six power cells/mL, confirming the eutrophic status attributed to this lake. Cellular densities were nearly homogeneously distributed in the water column. Mean values for bacterial abundance, obtained from three sampling depths (2,7, and 14 m) were 3.70, 4.23, and 3.66 times 10 to the six power cells/mL. In the epilimnion, phytoplankton productivity and community composition, as well as temperature, appeared to control bacterial development. Bacterial biomass varied from .005 to .435 mg C/L. Mean values for the three sampling depths were .081, .101, and .091 mg C/L. Although bacterial biomass was significantly correlated with bacterial abundance, only 45 to 65% of its variation could be explained by abundance. Individual cell biovolumes varied up to sixfold, from .014 cubic micrometers in spring and autumn to 0.090 cubic micrometers in summer. The largest bacterial cells and the most elevated bacterial biomass were reached when bacteria were attached to phytoplankton or detrital organic matter, primarily during summer. Mucilaginous phytoplankton, such as Gomphosphaeria and Sphaerocystis, was found to be particularly good substrate available for the development of large and attached bacteria. (Author's abstract)
W90-01112

**EFFECT OF MINERAL SUBSTRATE HARDNESS ON THE POPULATION DENSITY OF EPILITHIC MICROORGANISMS IN TWO ONTARIO RIVERS.**
University of Western Ontario, London. Dept. of Geology.
F. G. Ferris, W. S. Fyfe, T. Witten, S. Schultze, and T. J. Beveridge.
Canadian Journal of Microbiology CJMIAZ, Vol. 35, No. 7, p 744-747, July 1989. 3 fig, 2 tab, 12 ref.

Descriptors: *Microorganisms, *Ontario, *Rivers, *Mineralization, Canada, Microscopy, Microenvironment, Bacteria, Granites, Quartz, Basalts, Crystalline rocks, Algae, Water sampling.

Adherent epilithic microorganisms recovered from rocks submerged 10 to 20 cm in two different rivers were examined by electron microscopy and enumerated after dispersion in M-9 salts by viable plate counts. Bacterial cells concentrated in microcolonies were often observed attached to the surface of algae, cyanobacteria, and organic detritus. This structured communal mode of growth was common among epilithic microbial communities of different rock types. However, counts of heterotrophic bacteria from limestone were 10-fold to 100-fold greater than corresponding values from granite, gabbro, rhyolite, basalt, and quartz. Cyanobacteria and algae were an order of magnitude less abundant compared with their bacterial counterparts. These variations in population densities of epilithic microorganisms present on different rocks were inversely related to mineral substrate hardness. (Author's abstract)
W90-01113

**BENTHIC MICROBIAL ACTIVITY IN AN ANTARCTIC COASTAL SEDIMENT AT SIGNY ISLAND, SOUTH ORKNEY ISLANDS.**
Essex Univ., Colchester (England). Dept. of Biology.
D. B. Nedwell.
Estuarine, coastal and Shelf Science ECSSD3, Vol. 28, No. 5, p 507-516, May 1989. 4 fig, 36 ref. The Royal Society and the Natural Environment Research Council Grant GR3/6482.

Descriptors: *Benthic fauna, *Microorganisms, *Antarctic, *Marine sediments, Signy Island, South Orkney Islands, Amphipods, Sulfate reduction, Pyrite, Microbial activity.

Microbial activity in a marine sediment in Factory Cove, Signy Island, South Orkney Islands in the maritime Antarctic was examined during December 1987 and January 1988. The sediment was bioturbated by a dense amphipod population in the surface layer but oxygen penetrated to a depth of only 1.7 mm. The top 1 cm was light colored and contained negligible concentrations of acid-volatile sulfides. Below 1 cm the sediment was black and contained abundant sulfides. Sulfate reduction rates averaged .687 micromoles sulfate/square cm/day over the 0-15 cm horizon, equivalent to 1.38 micromoles organic carbon oxidized/square cm/day. Of the sulfate reduced, 60% was to tin-reducible products (including pyrite) and 40% to acid-volatile sulfides. Annual sulfate reduction was at least 250 micromoles sulfate/square cm/year. The sea water temperature varied only between -1.8-1 C, but the optimum temperature for sulfate reduction was 21 C. Oxygen uptake by the benthos averaged 5.33 micromole oxygen/square cm/day, equivalent to 5.33 micromole organic carbon oxidized/square cm/day. Aerobic respiration accounted for 79% of the organic carbon mineralization and sulfate reduction for 21%. (Author's abstract)
W90-01116

**NITROGEN CYCLING BETWEEN SEDIMENT AND THE SHALLOW-WATER COLUMN IN THE TRANSITION ZONE OF THE POTOMAC RIVER AND ESTUARY. II. THE ROLE OF WIND-DRIVEN RESUSPENSION AND ADSORBED AMMONIUM.**
Geological Survey, Reston, VA.
For primary bibliographic entry see Field 2L.
W90-01117

**EFFECTIVE WETLANDS POLICY: STICKS OR CARROTS.**
Iowa State Univ., Ames. Dept. of Botany.
For primary bibliographic entry see Field 6E.
W90-01118

**HYDROCHEMICAL REGIME AND WATER QUALITY IN RESERVOIRS IN CENTRAL ASIA (GIDROKHIMICHESKII REZHIM I KA-**

**CHESTVO VODY VODOKHRANILISHCH SREDNEI AZII).**
Sredneaziatskii Nauchno-Issledovatel'skii Inst. Irrigatsii, Tashkent (USSR).
V. A. Nickolaenko.
Gidrobiologicheskii Zhurnal GBZUAM, Vol. 25, No. 1, p 78-83, 1989. 2 fig, 3 tab, 10 ref. English summary.

Descriptors: *USSR, *Reservoirs, *Limnology, *Water quality, *Asia, Dissolved oxygen, Sulfates, Carbonates, Drinking water, Industrial water, Irrigation water, Oxygen balance.

The hydrochemical regime is presented for nine reservoirs in Central Asia located in various physiographical zones. Most of reservoirs in the foothill-mountain regions have water of the carbonate class with mineralization not exceeding 500 mg/L, but in the plains reservoir water is of the sulfate class with ions reaching 1000 mg/L and more. The oxygen regime is quite favorable for the development of aquatic biota. The concentration of biogenic elements and organic matter is not high. Water in most of reservoirs is of good and satisfactory quality. Oxygen concentration in reservoir water is high: 8.00-10.70 mg/L i.e. a saturation of 81-98%. Important characteristics of water in Central Asian reservoirs are as follows: (1) fully useful for drinking and household needs (aside from Kara-Kum where sulfate and minerals are high); (2) most reservoir water is ideal for irrigation; and (3) most reservoirs, with two exceptions in Uzbekistan, have water not hard enough for most industrial purposes. (Peters-PTT)
W90-01145

**IMPACT OF ATMOSPHERIC DEPOSITION ON THE AQUATIC ECOSYSTEM WITH SPECIAL EMPHASIS ON LAKE PRODUCTIVITY, NEWFOUNDLAND, CANADA.**
Areco Canada, Inc., Ottawa (Ontario).
For primary bibliographic entry see Field 5C.
W90-01151

**INFLUENCE OF ABIOTIC FACTORS AND DENSITY-DEPENDENT MECHANISMS ON BETWEEN-YEAR VARIATIONS IN A STREAM INVERTEBRATE COMMUNITY.**
Facultes Universitaires Notre-Dame de la Paix, Namur (Belgium). Unite d'Ecologie des Eaux Douces.
D. Rosillon.
Hydrobiologia HYDRB8, Vol. 179, No. 1, p 25-38, July 21, 1989. 7 fig, 3 tab, 48 ref.

Descriptors: *Stream biota, *Belgium, *Invertebrates, *Amphipods, *Gammarus, *Flooding, Flood benefits, Temperature.

Samples of invertebrates were taken in two seasons (October and April) over 5 years in a trout stream in Belgium. Diversity, total benthic invertebrate density, and densities of 27 of 34 taxa tested showed significant differences between years. Significant seasonal effects and interactions were observed in 18 and 7 taxa, respectively. The most common pattern of between-year variation was related to hydrological events (flooding) which caused low densities for many species. Most species recovered rapidly, but the recovery of some predators seemed to show a delay of one year. The amphipod Gammarus fossarum appeared to respond positively to flooding as well as the certain post-flood conditions. A significant positive correlation between mortality and the logarithm of initial density was obtained for 6 of 11 species tested. The relationships between mortality and abiotic factors such as water temperature, mean and maximum water level, were very poor. A hierarchy of environmental factors in the regulation of stream macroinvertebrate populations is suggested with: (1) exceptional abiotic events acting in a density-independent manner; and (2) biotic factors that may account for density-dependent regulation. (Author's abstract)
W90-01153

**LIMNOLOGY OF NATURALLY ACIDIC, OLIGOTROPHIC DUNE LAKES IN SUBTROPICAL AUSTRALIA, INCLUDING CHLOROPHYLL--PHOSPHORUS RELATIONSHIPS.**
Toronto Univ. (Ontario). Dept. of Botany.
P. M. Outridge, A. H. Arthington, and G. J. Miller.
Hydrobiologia HYDRB8, Vol. 179, No. 1, p 39-51, July 21, 1989. 9 fig, 4 tab, 32 ref.

Descriptors: *Acid lakes, *Oligotrophic lakes, *Limnology, *Acidic water, *Australia, *Phosphorus, *Chlorophyll, Phytoplankton, Dune lakes, Turbidity.

This study provides the most comprehensive physico-chemical and phytoplankton data yet available for Australian dune lakes, which are among the world's most naturally acidic and oligotrophic freshwaters. Seasonal and spatial variations were examined in Blue Lagoon and Lake Freshwater, two water-table window lakes in south-east Queensland. Like other dune lakes, they are acidic (minimum pH 4.20 and 4.55, respectively), polymictic water bodies with low concentrations of marine-derived major ions and almost undetectable levels of trace metals. While limnologically similar in winter, during spring-summer Lake Freshwater has significantly higher levels of chlorophyll-a, total phosphorus and turbidity than Blue Lagoon and other dune lakes, indicating seasonal mesotrophy. The key nutrient is total phosphorus, which has recently increased to a maximum of 17 microgram/l, due either to inputs from recreational sources, or to the death and decomposition of littoral vegetation resulting from falling water levels over the last decade. Inorganic nitrogen, though present only in small amounts, does not appear to limit the eutrophication process because of shift in phytoplankton dominance from the usual desmids and dinoflagellates to N2-fixing blue-green algae. A chlorophyll-total phosphorus linear regression derived for dune lakes indicates that at total phosphorus of less than 20 microgram/l chlorophyll yield is higher than in other lake types represented by regressions from the literature. This may be due to a more efficient utilization of the limited available phosphorus by dune lake algae which have adapted to the naturally oligotrophic environment. The implications of these findings for lake management are discussed. (Author's abstract)
W90-01154

**BACTERIAL UTILIZATION OF ALGAL EXTRACELLULAR PRODUCTS IN A SOUTHWESTERN RESERVOIR.**
Texas Univ. at Arlington. Dept. of Biology.
T. H. Chrzanowski, and J. G. Hubbard.
Hydrobiologia HYDRB8, Vol. 179, No. 1, p 61-71, July 21, 1989. 3 fig, 2 tab, 50 ref.

Descriptors: *Limnology, *Phytoplankton, *Carbon cycle, *Bacteria, *Texas, *Lakes, Monomictic lakes, Primary productivity.

Rates of carbon flow from phytoplankton to bacteria were estimated for Lake Arlington, Texas. The lake is a warm (annual temperature range 7 to 35 C), shallow, monomictic reservoir with limited macrophyte development in the littoral zone. Samples were collected from 6 depths within the photic zone from a site located over the deepest portion of the lake. Primary production and exudate production were calculated from NaH14CO3 incorporation. Bacterial production was calculated from (methyl-3H)-thymidine incorporation. Depth averaged primary production ranged from a seasonal low of 9.0 microgram C/l/h in January to a seasonal maximum of 153 microgram C/l/h during holomixis in September. Annual depth-averaged production was 67.8 +/-7.3 microgram C/l/h. Exudate production ranged between 21.9 and 54.2% of primary production and annually averaged 30.8%. Bacterial production ranged between 1.7 and 46.0 microgram C/l/h and annually averaged 16.0 +/-1.9 microgram C/l/h. Bacteria processed approximately 70% of exudate and incorporated 35% into biomass. Bacterial production was positively correlated with total primary production (r = 0.38, p less than 0.003, n = 6), particulate primary production (r = 0.34, p less than 0.004, n = 70) and bacterial uptake of exudate (r = 0.43, p less than 0.001, n = 68). While exudate was readily utilized by bacteria it did not appear to be produced in sufficient quantity or at a sufficient rate to serve as the sole or a major source of carbon supporting bacterial growth. (Author's abstract)
W90-01155

**DIEL ACTIVITY OF GAMMARUS PULEX (CRUSTACEA) IN A SOUTH SWEDISH STREAM: COMPARISON OF DRIFT CATCHES VS BAITED TRAPS.**
Maryland Univ., College Park. Dept. of Zoology.
J. D. Allan, and B. Malmqvist.
Hydrobiologia HYDRB8, Vol. 179, No. 1, p 73-80, July 21, 1989. 3 fig, 3 tab, 20 ref.

Descriptors: *Gammarus, *Sweden, *Stream biota, *Amphipods, Benthic fauna, Diurnal distribution.

We examined the relationship between drift and foraging activity in Gammarus pulex L. by comparing collections from the benthos, drift, and small traps baited with cheese. Two sites were employed, one with both sculpins and trout, and one lacking fish. Baited traps collected large numbers of G. pulex within as little as 15 min., demonstrating the effectiveness of chemical attractants. Limnephilid larvae also were attracted rapidly, and no counteracting influence on either taxon could be detected to result from a sculpin in an adjacent cage. Trap collections indicate a highly aggregated distribution and suggest that one use of this approach is for detecting small scale spatial patterns. Individuals of small size comprised the majority of the G. pulex population. Of three size categories used (less than 4 mm, 4-8 mm, greater than 8 mm total length), between 63 and 67% of the benthic collections were less than 4 mm long. Traps captured exclusively the two largest size classes of G. pulex. Drift collections consisted almost exclusively (93-100%) of less than 4 mm individuals during the day, and larger G. pulex appeared only in the night drift. Based on stomach analysis trout and sculpins selectively captured larger prey but this preference was proportional to fish size, as small sculpins captured relatively smaller prey. The rarity of larger G. pulex in the daytime drift appears to be attributable to greater risk of predation by day, but not to the absence of foraging activity in the amphipod, as baited traps and direct observation indicated that G. pulex is continuously active. (Author's abstract)
W90-01156

**ASSOCIATIONS AND DISTRIBUTION OF BENTHIC NEMATODES IN THE ETHIOPIAN RIFT VALLEY LAKES.**
Waterloo Univ. (Ontario). Dept. of Biology.
C. Tudorancea, and A. Zullini.
Hydrobiologia HYDRB8, Vol. 179, No. 1, p 81-96, July 21, 1989. 5 fig, 3 tab, 55 ref.

Descriptors: *Limnology, *Bioindicators, *Nematodes, *Ethiopia, *Benthic fauna, Crater lakes, Soda lakes, Conductivity, Lake sediments, Mesodorylaimus, Dorylaimus, Monhystera, Aphanolaimus, Tobrilus, Actinolaimus.

Nematodes are associated with the trophic status of waters and have also proved to be good indicators of aquatic pollution. Most of the present information refers to nematodes in the temperate region, and very little has been done on the nematodes in tropical freshwaters. The nematode associations in six Ethiopian rift lakes, one man-made lake, and three crater lakes were studied and related to water conductivity, lake depth and sediment particle size. The lakes investigated lie at moderate altitudes (1200-2000 m), are alkaline and vary in their conductivities. The rift lakes Abijata and Shala and the crater lakes Aranguadi, Kilotes and Chitu are soda lakes (K25 greater than 6000 microS/cm), while the remaining five lakes and the man-made Lake Koda are within the freshwater range of conductivity (K25 less than 6000 microS/cm). A total of 16 species were identified including six new species. The nematode associations varied between lakes and were restricted to very few species in each lake. Most nematodes were restricted to non-saline lakes. The most dilute Lake Zwai had a higher number of nematode species (12) and abundance than other lakes. The saline lakes Shala

and Kilotes had nematode assemblages made up of only a single species (Mesodorylaimus macrospiculum). No nematodes were found in the hypersaline crater Lake Chitu. Tobrilus africanus appeared more euryhaline than other nematodes occurring at conductivities as high as 15,000 microS/cm (Lake Abijata). five of the most common species (Dorylaimus sp., Monhystera stagnalis, Aphanolaimus tudoranceai, Tobrilus africanus and Actinolaimus perplexus) were associated with medium grained sand. A monthly variation in density of nematodes in Lake Zwai is also shown. (Author's abstract)
W90-01157

**UPSTREAM MIGRATION BY THE INVASIVE SNAIL, PHYSA ACUTA, IN CAPE TOWN, SOUTH AFRICA.**
Natal Univ., Pietermaritzburg (South Africa). Dept. of Zoology.
C. C. Appleton, and G. Branch.
South African Journal of Science SAJSAR, Vol. 83, No. 3, p 189-190, March 1989. 2 fig, 2 tab, 5 ref.

Descriptors: *South Africa, *Snails, *Migration, Physa, Rivers, Oxygen depletion, Water currents, Mollusks.

Quantitative data documenting the upstream migration of the snail, Physa acuta in the Liesbeeck river, Cape Town, during the decade 1978-1988 are presented. The river was sampled annually, in March, over a period of 11 years. Sampling took place at five stations along the rivers's 11.2-km course, and at a sixth station on the Black river, below the confluence of the two rivers. This sampling revealed not only the migration by P. acuta, but also substantial changes in its abundance at the colonized sites from year to year. The stretch of the Liesbeeck river colonized by P. acuta ranges from mildly acidic to neutral, is well oxygenated, low in dissolved salts and has a current velocity of 0.13-0.41 m/sec. The failure of P. acuta to reach the upstream Kirstenbosch site may be related to the lower pH and higher current velocity there. The Black river site where P. acuta was not found was, in contrast, oxygen-depleted and, although its conductivity was nearly three times that of the nearby Hartleyvale site on the Liesbeeck, it was still within the range commonly found in South African rivers. The snail has never been found in the Black river; the low oxygen saturation levels there could be a main factor preventing its establishment. An upstream migration rate of approximately 2.5 km/yr within an individual watercourse is of interest because it is the first such estimate pertaining to a benthic invasive gastropod. (Mertz-PTT)
W90-01169

**CHARACTERIZATION AND SIGNIFICANCE OF BETA-GLUCOSIDASE ACTIVITY IN LAKE WATER.**
Max-Planck-Inst. fuer Limnologie zu Ploen (Germany, F.R.). Abt. Mikrobenoekologie.
R. J. Chrost.
Limnology and Oceanography LIOCAH, Vol. 34, No. 4, p 660-672, June 1989. 9 fig, 2 tab, 48 ref. Poland Research Project CPBP 04.02.3.1.

Descriptors: *Enzymes, *Limnology, *Lakes, *Bacteria, *Heterotrophic bacteria, *Eutrophic lakes, Phytoplankton, Glucose, Algae, Plusssee, West Germany, Glucosidase.

Kinetics of beta-glucosidase activity and bacterial activity and cell numbers were measured in the euphotic zone and in the water column of Plusssee during spring phytoplankton bloom development and after its breakdown. Heterotrophic bacteria were the major producers of the enzyme. Activity of free beta-glucosidase, unassociated with bacteria were the major producers of the enzyme. Activity of free beta-glucosidase, unassociated with microbial cells, was negligible. beta-Glucosidase (BGlcA) displayed a distinct temporal and spatial distribution pattern in lake water. BGlcA was low when algal populations grew actively, but during the algal bloom breakdown BGlcA increased rapidly. The increase in BGlcA was proportional to the abundance of bacteria and to their heterotrophic uptake of glucose, as well as to bacterial production, measured by the thymidine incorporation method. In contrast to pH, BGlcA exhibited no obvious adaptation to ambient temperature of lake water. BGlcA produced by aquatic bacteria was under control of a repression-induction mechanism, and synthesis was derepressed when the level of directly assimilable hexoses fell below a critical level. The tight relationship between the rates of BGlcA and glucose uptake indicated the existence of a specific, coupled hydrolysis-uptake system in lacustrine bacteria. (Author's Abstract)
W90-01183

**SEASONAL PATTERNS OF BACTERIVORY BY FLAGELLATES, CILIATES, ROTIFERS, AND CLADOCERANS IN A FRESHWATER PLANKTONIC COMMUNITY.**
Georgia Univ., Athens. Dept. of Zoology.
R. W. Sanders, K. G. Porter, S. J. Bennett, and A. E. DeBiase.
Limnology and Oceanography LIOCAH, Vol. 34, No. 4, p 673-687, June 1989. 3 fig, 6 tab, 53 ref. NSF Grant BSR 84-07928.

Descriptors: *Food chains, *Food habits, *Limnology, *Seasonal variation, *Eutrophic Lakes, *Plankton, *Aquatic animals, *Grazing, Bacterivory, Flagellates, Rotifers, Protozoa, Crustaceans, Copepods.

Bacterivory in eutrophic lake Oglethorpe, Georgia, was determined by direct observation of tracer particle uptake by all members of the planktonic community. Heterotrophic flagellates dominated grazing at all times, accounting for 49-81% of grazing on an areal basis and up to 98% of grazing at some depths. Pigmented flagellates were major grazers during winter and spring blooms, when they contributed up to 45% of community grazing on an areal basis and 79% at depths of maximum abundance. In late spring to early summer, rotifers and ciliates were responsible for as much as 25 and 30% of bacterivory at some depths, but averages 3 and 11% over the year, respectively. Grazing impact of cladoceran crustaceans was generally $<$ 1% of the total. Bacterivory by copepods was not detected. Total bacterial mortality due to grazing ranged from 11 to 162% of bacterial cell production estimated from the incorporation of 3H thymidine. Use of 0.57 micrometer microspheres as tracers gave similar estimates of ingestion to fluorescently labeled bacteria in this system. The use of 4% ice-cold glutaraldehyde mixed 1:1 with the water sample was found to be equally effective to an acrolein-tannic acid mixture for reducing egestion of particles by protists. Therefore the findings are considered to be representative of bacterivory by the planktonic community in this eutrophic system. (Author's Abstract)
W90-01184

**EFFECTS OF FLOCCULATED HUMIC MATTER ON FREE AND ATTACHED PELAGIC MICROORGANISMS.**
Rhode Island Univ., Kingston. Graduate School of Oceanography.
L. J. Tranvik, and J. M. Sieburth.
Limnology and Oceanography LIOCAH, Vol. 34, No. 4, p 688-699, June 1989. 4 fig, 4 tab, 39 ref. NSF Grant No. OCE-8511365.

Descriptors: *Limnology, *Food chains, *Humic substances, *Oligotrophic lakes, *Organic matter, *Bacteria, *Flagellates, *Grazing, Flocculation, Dissolved organic carbon.

The effect of dissolved and particulate humic matter on pelagic microorganisms was studied in laboratory experiments. A humic concentrate was added to cultures of natural bacterial populations in either dissolved or partly flocculated form. Due to the occurrence of epibacteria attached to particles, a markedly higher bacterial yield was obtained when a fraction of the added carbon was flocculated. Attached bacteria apparently utilized flocs as well as dissolved organic carbon surrounding the particles. Both free and attached bacteria were grazed by phagotrophic flagellates. In addition to grazing attached bacteria, attached flagellates could ingest free bacteria. In 11 oligotrophic lakes, ranging from those with clear water to those heavily colored humic substances, a linearly increasing amount of both particulate material and particle-associated epibacteria was found in the pelagial with increasing humic content. Suspended detritius particles (humic flocculates) have a positive influence on the secondary productivity of humic lakes due to an enrichment of the heterotrophic epibacterial-bacterivorous flagellate segment of the microbial food web. (Author's Abstract)
W90-01185

**WHOLE-LAKE EXPERIMENTS: THE ANNUAL RECORD OF FOSSIL PIGMENTS AND ZOOPLANKTON.**
Notre Dame Univ., IN. Dept. of Biological Sciences.
P. R. Leavitt, S. R. Carpenter, and J. F. Kitchell.
Limnology and Oceanography LIOCAH, Vol. 34, No. 4, p 700-717, June 1989. 6 fig, 3 tab, 73 ref. NSF Grants Nos. BSR 86-04996, BSR 86-06271, and BSR 85-21832.

Descriptors: *Limnology, *Pigments, *Paleolimnology, *Lakes, *Sedimentation, *Plankton, *Fish populations, *Food chains, Zooplankton, Lime, Fossils.

The annual record of fossil pigments and zooplankton was compared with detailed contemporaneous records from two manipulated lakes from 1940 to 1986. Annually resolved sedimentary records accurately monitored known changes in plankton communities, identified periods of trophic change, and proved a powerful tool for examining long-term, complex interactions. Both Paul and Peter Lakes underwent the same three complete changes in their fish assemblages (trout, cyprinid, bass), and Peter Lake received repeated inputs of lime. Alterations in fish community composition produced long-lived changes in zooplankton communities that cascaded to the microbial level of the food web. Liming, in concert with trophic changes, caused distinctive phytoplankton dynamics in Peter Lake. Paleolimnological data recorded all major plankton dynamics known from coeval limnological data. Specifically, the sediment record showed transitions in cladoceran size structure and species composition, changes in water clarity resulting from both food web and chemical manipulations that affected vertical zonation of primary producers, and changes in absolute abundance of all algal divisions except dinoflagellates. Undegraded chlorophyll a indicated deep blooms and, in conjunction with chlorophyll c, fucoxanthin and beta-carotene, indicated metalimnetic chrysophytes. Transient (2-3 year) non-selective increases in sedimentation corresponded with increases in grazing rates. Isorenieratene indicated overlap of photic and anoxic zones, revealing changes in transparency and conditions for pigment preservation. (Author's Abstract)
W90-01186

**OXYGEN UPTAKE KINETICS IN THE BENTHIC BOUNDARY LAYER.**
Chalmers Univ. of Technology, Goeteborg (Sweden). Dept. of Analytical and Marine Chemistry.
P. O. J. Hall, L. G. Anderson, M. M. Rutgers van der Loeff, B. Sundby, and S. F. G. Westerlund.
Limnology and Oceanography LIOCAH, Vol. 34, No. 4, p 734-746, June 1989. 8 fig, 2 tab, 55 ref.

Descriptors: *Oxygen uptake, *Sediments, *Interstitial water, *Kinetics, *Benthic environment, *Boundary layers, Fjords.

A simple one-dimensional, transport-reaction model of oxygen uptake by sediments during incubation experiments assumes zero-order reaction kinetics for oxygen removal in the pore water of sediments and takes the apparent diffusive limitation posed by the benthic boundary layer into account. Model calculations are in excellent agreement with experimental data obtained during in situ benthic flux chamber experiments in Gullmarsfjorden, Sweden, during fall and winter. The boundary layer resistance, represented by a mean diffuse sublayer thickness, was estimated with a

series of radioactive tracers. The oxygen uptake curve was initially approximately linear but became exponential below approximately 100 micromoles oxygen. The half removal time of oxygen below 100 micromoles corresponds to a boundary layer resistance similar to that obtained with the radiotracers. The nearly constant rate of decrease of oxygen during the initial phase of the incubations suggests that incubation techniques can be used to obtain an approximate measure of the oxygen uptake rate of sediments as long as the concentration remains above the transition where the curve changes from approximately linear to exponential. This procedure, however, underestimates the oxygen uptake rate by 28-34% compared to model results. Model calculations also suggest that oxygen rates can differ substantially between chamber and outside sediments, especially when hydrodynamic conditions influencing the apparent boundary layer resistance are different within and outside chamber. (Author's Abstract)
W90-01188

**COMPARISON OF SURFACE AND DEPTH-INTEGRATED COMPOSITE SAMPLES FOR ESTIMATING ALGAL BIOMASS AND PHOSPHORUS VALUES AND NOTES ON THE VERTICAL DISTRIBUTION OF ALGAE AND PHOTOSYNTHETIC BACTERIA IN MIDWESTERN LAKES.**
Missouri Univ.-Columbia. School of Forestry, Fisheries and Wildlife.
M. F. Knowlton, and J. R. Jones.
Archiv fuer Hydrobiologie, Supplement AHBSA8, Vol. 83, No. 2, p 175-196, June 1989. 7 fig, 5 tab, 64 ref.

Descriptors: *Limnology, *Biomass, *Ecosystems, *Phosphorus, *Cycling nutrients, *Algae, *Photosynthetic bacteria, Water column, Dissolved oxygen, Chlorophyll, Phytoplankton, Water temperature, Temporal distribution, Aquatic environment.

Vertical profiles of temperature, dissolved oxygen and in vivo fluorescence and paired samples taken (1) at the surface or (2) as a composite from the oxygen saturated part of the water column, were collected from 48 lakes in Missouri, Iowa, Oklahoma, Kansas, and Arkansas during summers 1982-1983. Differences between surface and composite samples in chlorophyll and total phosphorus values were usually small (ca. 5%) but increased in water columns with surface temperature-clines where phytoplankton often formed subsurface layers. Differences between surface and composite samples were usually much less than temporal variation and can probably be neglected in large scale surveys intended to estimate seasonal averages. Fluorescence profiles showed diverse patterns in the vertical distribution of algal biomass but stable metalimnetic algal maxima were found only in Table Rock Lake, Missouri. Metalimnetic layers of green sulfur bacteria (Chlorobiaceae) were found in 9 reservoirs and seem to be the most common metalimnetic autotrophs in lakes in this region. (Author's abstract)
W90-01210

**SUMMER DISTRIBUTION OF NUTRIENTS, PHYTOPLANKTON AND DISSOLVED OXYGEN IN RELATION TO HYDROLOGY IN TABLE ROCK LAKE, A LARGE MIDWESTERN RESERVOIR.**
Missouri Univ.-Columbia. School of Forestry, Fisheries and Wildlife.
M. F. Knowlton, and J. R. Jones.
Archiv fuer Hydrobiologie, Supplement AHBSA8, Vol. 83, No. 2, p 197-225, June 1989. 13 fig, 4 tab, 59 ref.

Descriptors: *Ecosystems, *Cycling nutrients, *Phytoplankton, *Dissolved oxygen, *Lakes, *Reservoirs, *Hypolimnion, *Limnology, Seasonal variation, Inflow, Outflow, Density currents, Epilimnion.

Table Rock Lake is a large (17 cu km) hydropower reservoir with hypolimnetic discharge. In summer, nutrient-poor hypolimnetic outflow from an upstream reservoir (Beaver Lake) flows as a density current into the hypolimnion of the White River arm of Table Rock Lake with little effect on surface water quality. Nutrient-rich inflow from other tributaries enters the epilimnion where dilution and sedimentation cause extreme longitudinal gradients. Downlake declines of > 80% in concentrations of phosphorus and chlorophyll have been recorded in the James River and Long Creek arms in one or more years. In the White River arm, local nutrient inputs from Leatherwood Creek cause similar, but much smaller gradients. Algal biomass throughout the White River arm and in other downlake areas is highly correlated to phosphorus concentration both in the mixed layer and metalimnion. Other uplake reaches may be nitrogen limited, especially in late summer. Metalimnetic chlorophyll maxima develop in summer in most parts of the lake with communities numerically dominated by diatoms, especially Achnanthes minutissima, in downlake areas and bluegreens, flagellates and photosynthetic bacteria in headwater reaches. Oxygen depletion is most rapid near the sediments and in the lower metalimnion and is faster in headwater areas than near the dam. Discharge for power generation causes rapid replacement of hypolimnetic water near the dam increasing the temperature and decreasing oxygen concentrations. Discharge volume accounts for > 80% of interannual variation in hypolimnetic warming and oxygen depletion in summer. (Author's abstract)
W90-01211

**NUTRIENT CONCENTRATION-STREAM DISCHARGE RELATIONSHIPS DURING STORM EVENTS IN A FIRST-ORDER STREAM.**
Bucknell Univ., Lewisburg, PA. Dept. of Biology.
W. F. McDiffett, A. W. Beidler, T. F. Dominick, and K. D. McCrea.
Hydrobiologia HYDRB8, Vol. 179, No. 2, p 97-102, July 24, 1989. 2 fig, 2 tab, 14 ref.

Descriptors: *Limnology, *Stream discharge, *Storm water, *Nutrients, First-order streams, Phosphates, Nitrates, Path of pollutants, Calcium, Manganese, Nitrogen.

The relationship between nutrient element concentration and stream discharge during storm events was studied in a nutrient-rich first order stream. Stream concentrations of NO3-N, phosphate-P, Ca, and Mg were determined during the course of and following thunderstorms. Nutrient element trajectories were constructed for the elements monitored and some recognizable and reproducible patterns in nutrient concentrations emerged. NO3-N and phosphate-P generally increased in concentration during the early stages of increasing stream discharge resulting in general clockwise trajectory. Ca and Mg consistently showed decreases in concentration during rising water, but the pattern of the trajectories was less constant. The patterns seen for NO3-N and phosphate-P suggest surface runoff as their origin while the patterns for Ca and Mg reflect their primary origin in groundwater. The ability to detect these differences from the analysis of nutrient trajectories suggests the use of this technique for determining the source of other elements in streams. (Author's abstract)
W90-01276

**BENTHIC ALGAL RESPONSES TO N AND P ENRICHMENT ALONG A PH GRADIENT.**
Michigan Univ., Pellston. Biological Station.
H. J. Carrick, and R. L. Lowe.
Hydrobiologia HYDRB8, Vol. 179, No. 2, p 119-127, July 24, 1989. 3 fig, 5 tab, 39 ref.

Descriptors: *Lakes, *Streams, *Hydrogen ion concentration, *Benthos, *Wetlands, *Bogs, *Acidity, *Limnology, *Nitrogen, *Phosphorus, *Algal growth, Algae, Nutrients, Enrichment, Water pollution effects.

Nutrient enrichment and its effects on benthic algal growth, community composition, and average cell size was assessed across two sites of differing pH within a single habitat. Nutrients were added using in situ substrate, which released either N, P, or no additional nutrients (controls) at each site for 21 days. Upon collection, chlorophyll and biovolume standing stocks of the attached algal microflora were measured. Chlorophyll concentration was different among all treatments, accumulating greatest on P, followed by N, and the least on C substrata ($P < 0.001$) and was highest at site 2 ($P < 0.001$), while total algal biovolume was highest on P compared to both N and C substrata ($P < 0.05$) and did not vary between sites. Increased growth on P substrata was due to the enhanced biovolume to cell density ratios (as a measure of average cell size) were highest on P substrata over both N-enriched and control substrata ($P < 0.05$) and this pattern was similar between sites. Progression towards a community composed of larger cells following P enrichment observed along this pH gradient, seems to be related to the dominance of larger celled filamenteous green algae. Thus, nutrients exhibited greater control on benthic algal growth than did changes in hydrogen ion concentration. (Author's abstract)
W90-01277

**CARBON DIOXIDE EQUILIBRIA AND NUTRIENT AVAILABILITY IN TWO CULTURE PONDS AT NARAKKAL DURING THREE MONSOON AND POST-MONSOON MONTHS, JUNE-SEPTEMBER, 1984.**
Central Marine Fisheries Research Inst., Cochin (India).
C. P. Ramamirtham, and A. Mathew.
Indian Journal of Fisheries IJFIAW, Vol. 34, No. 2, p 192-197, 1987. 6 fig, 10 ref.

Descriptors: *Brackish water, *Limnology, *Fish farming, *Ponds, *Carbon dioxide, *Nutrients, *Monsoons, Culture ponds, Phosphates, Nitrates, Nitrites, Salinity, Dissolved oxygen, Hydrogen ion concentration, Seasonal variation.

The variation of some biological parameters (carbon dioxide, pH, phosphate, nitrate, nitrite, salinity, dissolved oxygen and temperature) in two brackish fish culture ponds is discussed along with their diurnal variations. The high values of dissolved oxygen were associated with high pH values also. The range of pH in both the ponds was between 7.7 and 8.25. Comparatively, the pH values were lower during the peak monsoon period. The minimum occurred during late August when the temperature was also minimal. These relationships are reflected in the time distribution pattern of free carbon dioxide in both the ponds. The maximum value in pond A was 3.9 mg/l and in pond B was 4.9 mg/l. These maxima were associated with minimum pH and minimum dissolved oxygen content. The general trend was an increase in the values with time. The relation between pH and carbon dioxide appeared to be more regular than the relation between oxygen and carbon dioxide. It is indicated that the nutrient contents, free carbon dioxide and temperature conditions in the culture ponds were subject to a wide range of variations during the period of observation. (Miller-PTT)
W90-01286

**DETERMINATION OF NUTRIENT UPTAKE KINETIC PARAMETERS: A COMPARISON OF METHODS.**
British Columbia Univ., Vancouver. Dept. of Oceanography.
P. J. Harrison, J. S. Parslow, and H. L. Conway.
Marine Ecology Progress Series MESEDT, Vol. 52, No. 3, p 301-312, March 22, 1989. 2 tab, 7 fig, 22 ref.

Descriptors: *Limnology, *Lakes, *Rivers, *Nutrients, *Chrysophyta, Cultures, Absorption, Kinetics, Incubation, Comparison studies, Limiting nutrients, Phosphates, Ammonia.

Three methods which have been used to determine nutrient uptake kinetic parameters were compared using steady-state NH4-limited cultures of the chrysophyte Pseudopedinella pyriformis. The first two methods involved a multiple flask incubation where different concentrations of substrate were added to each flask. Method 1 used a variable incubation time, while the incubation time of Method 2 was short and constant. The third

method, the pertubation method, involved one large addition of the substrate to one culture and the nutritional past history varied throughout the experiment. This method was used also with the diatoms Skeletonema coatum and Chaetoceros debilis in Si-limited chemostats. Results indicate that, for nutrient-limited cultures, kinetic parameters are best estimated using multiple additions of the substrate and a short constant incubation time (Method 2). It appears that this method determined membrane transport, which is still not completely free of feedback inhibition even when the incubation time is very short (2 min). The short incubation time is necessary because the maximal uptake velocity (Vm) decreases with increasing incubation time especially for phosphate and ammonium. Method 3 provides valuable information on a third parameter, Vi, the approximate assimilation rate of the limiting nutrient to N-limited or Si-limited Skeletonema costatum and Chaetoceros debilis revealed that if the additions were small(2 microM NH4), there was no change in subsequently determined uptake kinetic parameters. if the sequential additions were larger (6 microM), then the maximal uptake rate slowed with time. (Author's abstract)
W90-01290

**SALT CONCENTRATIONS AND CHEMICAL TYPES OF LAKE, RIVER, SNOW, AND HOT SPRING WATERS FROM THE TIBETAN PLATEAU.**
Shiga Univ., Otsu (Japan). Faculty of Liberal Arts and Education.
M. Kawashima, and T. Nishiyama.
Japanese Journal of Limnology RIZAAU, Vol. 50, No. 2, p 93-104, April 1989. 7 fig, 4 tab, 8 ref. Japan Ministry of Education Grant-in-Aid for Overseas Field Research no. 60041084.

Descriptors: *Water chemistry, *Geochemistry, *Groundwater, *Lakes, *Rivers, *Snow, *Hot springs, *Salinity, *Tibetan plateau, Sodium, Potassium, Manganese, Calcium, Chemical properties, Chlorides, Sulfates, Water quality.

Concentrations of Na(+), K(+), Mg(++), Ca(++), Cl(-), SO4(--) and alkalinity in water samples from the Tibetan Plateau were analyzed. The samples were from 27 lake waters, 82 river waters, 19 snows, 7 hot spring waters and 1 groundwater. Almost all the snows and rivers were fresh (< 0.5 g/l in salt concentration), while most of the lakes and spring waters were saline. In the north of the plateau, where the climate is more arid than in the south, the river waters tended to have a higher salt concentration than in the south. Almost all the lakes investigated were closed and saline. The chemical type of the lake waters was Na-Cl and/or Na-SO4 in the northern and Na-HCO3 in the southern part of the plateau, whereas the type of fresh river waters and snows was Ca-HCO3. (Author's abstract)
W90-01294

**TIDAL EXCHANGE IN LAKE SHINJI UNDER LOW DISCHARGE CONDITIONS.**
Shamine Prefectural Inst. of Public Health and Environmental Science, Matsue (Japan).
Y. Ishitobi, H. Kamiya, K. Hayashi, and M. Gomyoda.
Japanese Journal of Limnology RIZAAU, Vol. 50, No. 2, p 105-113, April 1989. 6 fig, 3 tab, 14 ref.

Descriptors: *Lakes, *Tidal currents, *Flow discharge, *Lake Shinji, Tidal exchange, Coastal lakes.

The tidal exchange in Lake Shinji, an inner coastal lake connected to a lower one by a long narrow channel, was investigated under low discharge conditions. Fixed point observations at the cross-section in the uppermost reaches of the channel were executed. Evaluation from the analysis of the velocity and salinity profiles showed that tidal exchange was the dominant component responsible for the inward salt flux under normal tidal conditions. Moreover, longer term variations of water level with an amplitude superior to the tidal one were recognized in Lake Shinji, and were considered to be another factor of the water exchange between this inner lake and a lower one. (Author's abstract)
W90-01295

**LIMITING NUTRIENTS OF ALGAL GROWTH IN USHIKU MARSH, (IN JAPANESE).**
National Inst. for Environmental Studies, Tsukuba (Japan). Water and Soil Environment Div.
For primary bibliographic entry see Field 5C.
W90-01297

**C:N:P RATIO OF MICROCYSTIS AND ANABAENA (BLUE-GREEN ALGAE) AND ITS IMPORTANCE FOR NUTRIENT REGENENERATION BY AEROBIC DECOMPOSITION.**
Kyoto Univ., Otsu (Japan). Otsu Hydrobiological Station.
For primary bibliographic entry see Field 5C.
W90-01298

**PRIMARY PRODUCTION OF DIFFERENT PHYTOPLANKTON SIZE CLASSES IN AN OLIGO-MESOTROPHIC SWISS LAKE, (JAPANESE).**
Eidgenoessische Anstalt fuer Wasserversorgung, Abwasserreinigung und Gewaesserschultz, Duebendorf (Switzerland). Inst. of Aquatic Sciences.
U. Uehlinger, and J. Bloesch.
Archiv fuer Hydrobiologie AHYBA4, Vol. 116, No. 1, p 1-21, Jul 1989. 10 fig, 2 tab, 72 ref. English summary.

Descriptors: *Oligotrophic lakes, *Mesotrophic lakes, *Phytoplankton, *Limnology, *Primary productivity, Light intensity, Nutrients, Zooplankton grazing, Seasonal variation, Diurnal patterns, Vertical distribution, Chlorophyll a, Biomass, Lake Lucerne, Switzerland, Turbulent flow.

Vertical, diurnal and seasonal patterns of primary production for six different size fractions (> or = 30 microns, 12-30 microns, 3-12 microns, 0.8-3 microns, 0.2-0.8 microns, < or = 0.2 microns) were investigated in oligo-mesotrophic Lake Lucerne, Switzerland. During winter and the clear water phase in June the netplankton (> or = 30 micron) provided the bulk primary production (43-83%). However, during summer stratification (May-October 1984) the phytoplankton < or = 30 micron, mainly diatoms and flagellates, contributed 60-100% to the total primary production, reflecting the high amount of 60-90% (45-90%) to the total biomass (chlorophyll a) concentration. Throughout the year the relative percentage of the picoplankton (< or = 3 micron) to primary production was 34% (2-62%), and the smallest size fractions, < or = 0.8 micron micron and < or = 0.2 micron, contributed < or = 12% and < or = 6%, respectively. Vertical and temporal changes in light intensity did not significantly influence the patterns of size distributions. The relative importance of nanno- and picoplankton for primary production is not only dependent on the trophic state of a lake, but also on the ecological stress such as nutrient supply, turbulence, and zooplankton grazing. (Author's abstract)
W90-01299

**PROCESSES CONTROLLING THE BENTHIC REGENERATION AND SEDIMENTARY ACCUMULATION OF BIOGENIC SILICA IN LAKE MICHIGAN.**
Maryland Univ., Cambridge. Horn Point Environmental Labs.
D. J. Conley, and C. L. Schelske.
Archiv fuer Hydrobiologie AHYBA4, Vol. 116, No. 1, p 23-43, Jul 1989. 8 fig, 4 tab, 66 ref. NSF grant OCE-82-16588.

Descriptors: *Limnology, *Lake Michigan, *Lake sediments, *Silica, *Benthic environment, Sedimentation rates.

Processes controlling the benthic regeneration of biogenic silica (BSi) and factors affecting the accumulation of BSi in Lake Michigan sediments were investigated. Dissolved silica (DSi) fluxes measured directly by core incubation ranged from 2.3-10.3 mg SiO2/sq cm/yr and were 1-10 times greater than diffusive DSi fluxes calculated from pore water DSi concentration gradients which ranged from 0.4-5.3 mg SiO2/sq cm/yr. Benthic invertebrates were probably not a significant factor in enhancing DSi fluxes. DSi fluxes measured from cores could be predicted from the surficial sediment BSi concentration in cores by a saturation curve. At high surficial BSi concentrations DSi fluxes appeared to be limited by diffusive transfer of DSi into overlying waters. Experiments in which the upper 2 mm of sediment was removed confirmed the importance of BSi on the sediment surface to DSi fluxes. An empirical model was developed that illustrates the effects of mass sedimentation rate on BSi accumulation in sediments. The interaction between supply rate of BSi and mass sedimentation rate control BSi accumulation in Lake Michigan sediments. (Author's abstract)
W90-01300

**SPECIATION PHOSPHORUS TECHNIQUES IN THE SEDIMENTS: DISCUSSION AND PROPOSITIONS TO EVALUATE INORGANIC AND ORGANIC PHOSPHORUS (LES METHODES DE SPECIATION DU PHOSPHORE DANS LES SEDIMENTS: CRITIQUES ET PROPOSITIONS POUR L'EVALUATION DES FRACTIONS MINERALES ET ORGANIQUES).**
Rennes-1 Univ. (France). Lab. d'Evolution des Systemes.
J. C. Bonzongo, G. Bertru, and G. Martin.
Archiv fuer Hydrobiologie AHYBA4, Vol. 116, No. 1, p 61-69, Jul 1989. 5 tab, 16 ref. English summary.

Descriptors: *Chemical analysis, *Water analysis, *Speciation, *Lake sediments, *Organic compounds, *Phosphorus, Aquatic bacteria, Pollutant identification, Muramic acid, Fulvic acids, Humic acids.

An investigation of muramic acid evaluated by chemical speciation techniques shows that drastic conditions alter organic P. P-Ca is overestimated because of bacterial lysis; P residuals come from fulvic and humic acids. Treatment with H2O2 30%, NaHCO3 0.5 M pH 8.5 and chloroform allows inorganic P, bacteria and particulate organic P to be determined in sediments. (Author's abstract)
W90-01302

**LITTER CONSUMPTION BY INVERTEBRATES FROM AN AUSTRALIAN TROPICAL RAINFOREST STREAM.**
James Cook Univ. of North Queensland, Townsville (Australia). Dept. of Zoology.
R. G. Pearson, and R. K. Tobin.
Archiv fuer Hydrobiologie AHYBA4, Vol. 116, No. 1, p 71-80, Jul 1989. 2 fig, 3 tab, 24 ref.

Descriptors: *Rain forests, *Streams, *Biodegradation, *Decomposing organic matter, *Aquatic insects, *Caddisflies, *Mayflies, Tropical regions, Larvae, Nutrients, Yuccabine Creek, Australia.

Larvae of the caddisflies Anisocentropus sp. (Calamoceratidae) and Triplectides sp. (Leptoceridae), and the mayfly Atalonella sp. (Leptophlebiidae), collected from Yuccabine Creek, an upland tropical rainforest stream, were fed soaked green leaves of Ardisia brevipedata (Myrsinaceae) and Rhodomyrtus trineura (Myrtaceae) in the laboratory. The larvae of both caddis species caused considerable breakdown of leaf discs and production of fine particulate organic matter. The proportions of total processing due to the caddis larvae ranged from 34.8% (Anisocentropus sp. fed Ardisia brevipedata leaves) to 82.5% (Anisocentropus sp. fed R. trineura leaves). Atalonella sp. did not feed on the fresh leaf material. Field and laboratory decomposition rates reflected initial nutrient content of the leaves as well as changes in nutrient levels associated with the decomposition process. In the laboratory R. trineura leaves (2.95% N) were preferred to A. brevipedata leaves (1.45% N) which, in the field, were preferred to Rhodamnia sessiliflora (Myrtaceae) leaves (1.08% N). (Author's abstract)
W90-01303

**EPILITHIC ALGAL COMMUNITIES FROM RIVER SEGURA BASIN, SOUTHEASTERN SPAIN.**
Murcia Univ. (Spain). Dept. de Biologia Vegetal.
M. Aboal.
Archiv fuer Hydrobiologie AHYBA4, Vol. 116, No. 1, p 113-124, Jul 1989. 2 fig, 4 tab, 18 ref.

Descriptors: *Eutrophication, *Spain, *Algae, *Water chemistry, *Saline water, *Water pollution effects, Species composition, Aquatic bacteria, River Segura Basin.

An account is given of the floristic composition of epilithic algal communities from the River Segura Basin, southeastern Spain. Four sections can be delimited depending on the physicochemical characteristics of water, i.e.: whether it is clean, eutrophicated, salt or polluted water. The first zone is restricted to headwaters, the second and third to middle watercourse and the last to lower watercourse. The River Segura is strongly regulated (it possesses 18 reservoirs) and as a result of this its natural state has been altered because the maximal flow occurs in summer. Cyanophyceae are dominant in clean water but some species are also the most resistant to pollution. Chlorophyceae are more diversified in headwaters but in saltwater they are predominant, although some Chlorophyceae species are ubiquitous and tolerate a great variability of conditions. Rhodophyceae are characteristic of clean waters but some species live on saltwater. Bacillariophyceae rarely develop masses visible to the naked eye. The biological type predominant is the gelatinous aggregate in the whole basin except in salt waters where the filaments are better represented. Bacteria can form conspicuous thalli in most polluted streams. (Author's abstract)
W90-01304

**RESPONSE OF A FRESHWATER MARSH PLANT COMMUNITY TO INCREASED SALINITY AND INCREASED WATER LEVEL.**
Louisiana State Univ., Baton Rouge. Center for Wetland Resources.
K. L. McKee, and I. A. Mendelssohn.
Aquatic Botany AQBODS, Vol. 34, No. 4, p 301-316, August 1989. 5 fig, 4 tab, 17 ref. Minerals Management Service, New Orleans; contract no. 14-12-0001-30252.

Descriptors: *Marsh plants, *Saline water intrusion, *Salinity, *Plant physiology, *Plant growth, Species composition, Water level, Panicum, Leersia, Sagittaria.

Field and greenhouse experiments in which salinity and elevation were manipulated demonstrated that the response of freshwater marshes to saltwater intrusion may be variable and dependent upon a number of factors including: species composition; level, duration, and abruptness of exposure to saline water; flooding depth; a source of propagules of more salt-tolerant species. In the field, saltwater intrusion was simulated by transplanting swards of a freshwater marsh to a higher salinity area. The three dominant species, Panicum hemitomon, Leersia oryzoides, and Sagittaria lancifolia, succumbed to the sudden increase in salinity to 15 per mil. However, the denuded plots were rapidly invaded by more salt-tolerant species that were present in the higher salinity marsh. Although growth was reduced, P. hemitomon and L. oryzoides were relatively tolerant of salinities up to 9.4 per mil for at least 1 month in the greenhouse. S. lancifolia was less tolerant of salinity increases and showed symptoms of tissue damage at 4.8 per mil. A decrease in elevation, which resulted in an increase in mean water level and a more reduced soil environment, caused a significant decrease in live above-ground biomass and stem density in the experimental field plots. (Author's abstract)
W90-01307

**ABOVE-GROUND BIOMASS VARIATION IN CAREX ROSTRATA STOKES IN TWO CONTRASTING HABITATS IN CENTRAL SWEDEN.**
Uppsala Univ. (Sweden). Inst. of Ecological Botany.
A. B. C. Hultgren.
Aquatic Botany AQBODS, Vol. 34, No. 4, p 341-352, August 1989. 3 fig, 1 tab, 24 ref.

Descriptors: *Rooted aquatic plants, *Plant growth, *Lakes, *Marshes, *Limnology, *Reservoirs, Carex, Biomass, Nutrients, Seasonal variation, Water level, Sweden.

Biomass development and seasonal maximum above-ground biomass of the perennial Carex rostrata were studied in two different habitats for 3 years in central Sweden. In a mire with a small water level amplitude, the shoot size, density and seasonal maximum above-ground biomass of the species fluctuated only little between years. In a reservoir with a water level changing much within and between years, the shoot size and density of C. rostrata fluctuated, but in opposite directions so that the maximum above-ground biomass remained at the same level. The regulation of the development of new shoots under oligotrophic conditions with total biomass controlled by scarcity of plant nutrients is discussed. If the supply of nutrients increases in sparsely vegetated stands in a formerly stable environment the plants could theoretically react in 4 ways: (1) the ratio between dry mass and length might increase; (2) the stand density might increase; the plant then invests in shoot formation instead of an increased dry mass of single shoots; (3) turnover of shoots might increase; (4) the flowering frequency might increase. The highest record of above-ground biomass was 220 g/sq m in the shallow water area of the reservoir. (Author's abstract)
W90-01309

**GROWTH IN LENGTH OF CAREX ROSTRATA STOKES SHOOTS IN RELATION TO WATER LEVEL.**
Uppsala Univ. (Sweden). Inst. of Ecological Botany.
A. B. C. Hultgren.
Aquatic Botany AQBODS, Vol. 34, No. 4, p 353-365, August 1989. 4 fig, 2 tab, 16 ref.

Descriptors: *Rooted aquatic plants, *Plant growth, *Lakes, *Marshes, *Limnology, *Reservoirs, Carex, Water level, Seasonal variation, Sweden.

The pattern of growth leading to length increment and the influence of water depth on length of Carex rostrata shoots were studied in 4 different habitats of central Sweden. Individual shoots were studied in permanent plots from 1981-86. The water level is an important factor for growth of C. rostrata shoots, especially during early summer, when most of the length increment takes place. There are differences in the size of shoots depending on their age. The sterile shoots can continue their length increment throughout the season and differ from the fertile shoots which cease their growth after flowering. This study illustrates that a clonal species which lives under fluctuating water conditions can adapt both size and density of its shoots, and considerably increase their size and reduce their density in years with unusually high water level. (Author's abstract)
W90-01310

**WATER TEMPERATURE AND FRESHWATER MACROPHYTE DISTRIBUTION.**
Winnipeg Univ. (Manitoba). Dept. of Biology.
E. Pip.
Aquatic Botany AQBODS, Vol. 34, No. 4, p 367-373, August 1989. 2 tab, 23 ref.

Descriptors: *Aquatic plants, *Macrophytes, *Lotic environment, *Ponds, *Limnology, *Temperature effects, *Lakes, Water temperature, Seasonal variation, Species composition, Species distribution.

Distributions of aquatic macrophytes and community species richness were examined in relation to water temperature at 345 sites in central North America. No significant interspecific differences were found for the monthly temperature ranges of the various macrophytes found within each of the ponds, lakes and lotic habitats during the growing season in the area studied. However, some species showed significant differences when all habitat types were pooled. Species richness was positively correlated with maximum seasonal water temperature in lakes. Temperature in itself does not appear to be an important factor governing the distribution of macrophytes within the study area, although it may operate through other site variables such as water body size and type, and through indirect effects on water chemistry. (Author's abstract)
W90-01311

**ROLE OF BOTTOM SEDIMENTS IN SUSTAINING PLANKTON PRODUCTION IN A LAKE ECOSYSTEM: EXPERIMENTAL DEMONSTRATION USING ENCLOSED WATER BODIES IN A SHALLOW EUTROPHIC LAKE.**
Nagoya Univ. (Japan). Water Research Inst.
M. Sakamoto, H. Hayashi, A. Otsuki, K. Aoyama, and Y. Watanabe.
Ecological Research (Kyoto) ECRSEX, Vol. 4, No. 1, p 1-16, April 1989. 4 fig, 2 tab, 42 ref. Ministry of Education, Science and Culture, Japan, Grant-in-Aid for Special Project Research no. 60129034.

Descriptors: *Limnology, *Eutrophic lakes, *Zooplankton, *Phytoplankton, *Bottom sediments, *Nutrients, *Primary productivity, Phosphorus, Nitrogen, Carbon, Chlorophyll, Lake Suwa, Japan.

Using large enclosures set in Lake Suwa, experimental studies were conducted to examine the effects of bottom sediments on plankton production in a natural lake ecosystem. Successive changes in biotic and abiotic components in two types of enclosure with and without bottom sediments were surveyed throughout a one-month period in the early fall of 1985. Remarkable differences were found between the two types of enclosure with regard to the time courses of abundance of chlorophyll, PON (particulate nitrogen), particulate phosphorus, total nitrogen, total phosphorus, and zooplankton as well as those of POC (particulate carbon)/PON and POC/chlorophyll ratios and primary production rate in terms of mg N/sq m/day. Quantitative examination of the major causes of these differences revealed that the release of N and P from the bottom sediments was significantly effective for sustaining the active production of phytoplankton cells with a high N and P content, subsequently resulting in active zooplankton growth. (Author's abstract)
W90-01313

**PRODUCTION ECOLOGY OF PHYTO- AND ZOOPLANKTON IN A EUTROPHIC POND DOMINATED BY CHAOBORUS FLAVICANS (DIPTERA: CHAOBOLIDAE).**
National Inst. for Environmental Studies, Tsukuba (Japan). Environmental Biology Div.
T. Iwakuma, K. Shibata, and T. Hanazato.
Ecological Research (Kyoto) ECRSEX, Vol. 4, No. 1, p 31-53, April 1989. 10 fig, 7 tab, 59 ref.

Descriptors: *Eutrophic lakes, *Ponds, *Phytoplankton, *Zooplankton, *Limnology, *Aquatic insects, *Daphnia, *Primary productivity, *Secondary productivity, Chaoborus, Solar radiation, Chlorophyll a, Phosphorus, Nitrogen, Seasonal variation, Biomass, Larvae.

Primary production of phytoplankton and secondary production of a daphnid and a chaoborid were studied in a small eutrophic pond. The gross primary production of phytoplankton was 290 g C/sq m per 9 months during April-December. Regression analysis showed that the gross primary production was related to the incident solar radiation and the chlorophyll a concentration and to either total P or total inorganic N concentration. The mean chlorophyll a concentration (14.2 mg/cu m), however, was about half the expected value upon P loading of this pond. The mean zooplankton biomass was 1.60 g dry weight/sq m, of which Daphnia rosea and cyclopoid copepods amounted to 0.69 and 0.61 g dry weight/sq m, respectively. The production of D. rosea was high during May-July and October and the level for the whole 9 months was 22.6 g dry weight/sq m. Chaoborus

flavicans produced 10 complete and one incomplete cohorts per year. Two consecutive cohorts overlapped during the growing season. The maximum density, mean biomass, and production were 19,100 sq m, 0.81 g dry weight/sq m, and 11.7 g dry weight/sq m/yr, respectively. As no fish was present in this pond, the emerging biomass amounted to 69% of larval production. The production of C. flavicans larvae was high in comparison with zooplankton production during August-September, when the larvae possibly fed not only on zooplankton but also algae. (Author's abstract)
W90-01314

**GROWTH OF MACROPHYTES AND ECOSYSTEM CONSEQUENCES IN A LOWLAND DANISH STREAM.**
Copenhagen Univ., Hilleroed (Denmark). Det Ferskvands-Biologiske Lab.
K. Sand-Jensen, E. Jeppesen, K. Nielsen, L. Van der Bijl, and L. Hjermind.
Freshwater Biology FWBLAB, Vol. 22, No. 1, p 15-32, August 1989. 12 fig, 2 tab, 50 ref.

Descriptors: *Macrophytes, *Rooted aquatic plants, *Submerged plants, *Plant growth, *Streams, *Lotic environment, Water velocity, Light, Sedimentation, Biomass, Diatoms, Macroinvertebrates, Population dynamics, Sago pondweed, Cladophora, Sparganium, River Susa, Denmark.

The River Susa is a small, nutrient-rich stream situated in an open landscape with clayish subsoil under intensive cultivation. Discharge was variable daily and seasonally due to low groundwater input. Above-ground development of submerged macrophytes was restricted to late May to November, when water velocity and depth were low. Dominant macrophytes were rooted Potamogeton pectinatus and Sparganium emersum and unrooted Cladophora. Biomass development was closely related to light availability. Growth rates of macrophytes were linearly related to light availability when self-shading was accounted for. P. pectinatus grew rapidly in May-June, concentrated the biomass at the water-surface during July-August, and then declined exponentially when the shoots became basally senescent. S. emersum had linear, flexible leaves that were continuously replaced from a basal meristem. S. emersum was less susceptible to high water velocities than P. pectinatus and the biomass declined later and at lower rates during autumn. S. emersum also regrew after cutting that left its meristem intact in the sediment. Unrooted Cladophora developed a high biomass during sunny periods and subsequently disappeared at high discharges. The summer biomass of rooted macrophytes was greater in years with high summer discharge, whereas the biomass of Cladophora and of the epiphytic microbial community was lower due to scouring. Submerged macrophytes played a key role in structure and functioning of the ecosystem. They reduced water velocities 2-fold to 4-fold during summer and promoted extensive organic sedimentation. The biomass of benthic diatoms declined parallel to increased macrophyte shading and sedimentation. In addition, submerged macrophytes formed a large substratum for macroinvertebrates and for a microbial community. (Author's abstract)
W90-01315

**DECOMPOSITION OF LEAF LITTER EXPOSED TO SIMULATED ACID RAIN IN A BUFFERED LOTIC SYSTEM.**
Calgary Univ. (Alberta). Aquatic Ecology Section.
For primary bibliographic entry see Field 5C.
W90-01316

**MACROINVERTEBRATE MOVEMENTS IN A LARGE EUROPEAN RIVER.**
Lyon-1 Univ., Villeurbanne (France). Lab. d'Ecologie des Eaux Douces.
B. Cellot.
Freshwater Biology FWBLAB, Vol. 22, No. 1, p 45-55, August 1989. 1 fig, 5 tab, 69 ref.

Descriptors: *Benthic fauna, *Macroinvertebrates, *Lotic environment, *Aquatic drift, Diurnal rhythm, Seasonal variation, Population density, Rhone River, France.

Quantitative variations in downstream movements of benthic macroinvertebrates were studied in a large European river, the Rhone, upstream from Lyon. Artificial substrates were suspended at 3 depths in the water column, both near a bank and in mid-channel, monthly from December 1978 to March 1980. Drift nets were used to determine the diurnal rhythm in drift and to investigate the efficiency of the suspended artificial substrates in capturing the drifting macrofauna. Drift densities (number and biomass) reached a maximum during summer, especially near the river bank, and at night. Mean individual weight of organisms was higher close to the bottom and at night. Artificial substrates were reliable, but underestimated drift by about a quarter in number and a sixth in biomass, compared with drift nets. Two detailed analyses of the drift distribution across the width of the river revealed similar densities along both banks, and uniformity in the channel as a whole. Mean annual drift densities estimated for the section of river were 100 individuals/100 cu m and 60 mg dry weight/100 cu m. These densities are similar to those obtained from other temperate rivers. (Author's abstract)
W90-01317

**EXPERIMENTAL COLONIZATION OF SAND, GRAVEL AND STONES BY MACROINVERTEBRATES IN THE ACHERON RIVER, SOUTH-EASTERN AUSTRALIA.**
Monash Univ., Clayton (Australia). Dept. of Zoology.
T. J. Doeg, R. Marchant, M. Douglas, and P. S. Lake.
Freshwater Biology FWBLAB, Vol. 22, No. 1, p 57-64, August 1989. 2 fig, 3 tab, 13 ref. Australian Water Resources Advisory Committee grant no. 85/3.

Descriptors: *Benthic fauna, *Macroinvertebrates, *Lotic environment, *Aquatic drift, *Colonization, Sand, Gravel, Stones, Acheron River, Australia.

The contribution of drift to macroinvertebrate colonization was studied over 10 days using pairs of substratum-filled trays, one suspended above the streambed (and thus able to be colonized by drift only) and one buried flush with the streambed (and thus open to colonization from all directions). Trays were filled with sand, gravel or stones. Colonization of sand-filled trays was rapid, being completed within 24h (i.e. no subsequent change in numbers of individuals per tray); colonization of gravel or stone-filled trays was not completed by the end of the experiment. Drift contributed an average of 86% of the colonizing fauna of the sand-filled trays, 36% of the fauna of the gravel-filled trays and 25% of the fauna of the stone-filled trays. The low contribution of the drift to the gravel and stones is at odds with some studies which, using similar techniques, suggest that drift is the primary source of colonizing individuals. Most individual species showed low contributions by drift to colonization, with the majority having contributions under 66%. Distinct differences were noted between the fauna colonizing the sand-filled trays and those colonizing the gravel or stone-filled trays (which were similar). Several species common in the drift were rare in the colonizing fauna and several species which were common colonizers were absent or rare in the drift. (Author's abstract)
W90-01318

**EFFECTS OF TEMPERATURE ON THE RATE OF DEVELOPMENT OF EGGS OF A PLANKTONIC WATER MITE, PIONA EXIGUA.**
Otago Univ., Dunedin (New Zealand). Dept. of Zoology.
M. I. Butler, and C. W. Burns.
Freshwater Biology FWBLAB, Vol. 22, No. 1, p 65-70, August 1989. 1 fig, 3 tab, 32 ref.

Descriptors: *Temperature effects, *Mites, *Eggs, Water temperature, Piona.

The eggs of a planktonic, predatory water mite Piona exigua were reared in the laboratory at constant temperatures ranging from 10-28 C. Egg development rates increased with increase in temperature. Five models describing the effect of temperature on egg development times were fitted to the data. The variances of the egg hatching times at each temperature differed widely, but these variations were not made more equal by ln-transformation. A simple power curve, fitted to the raw data, accounted for > or = 97% of the variation in the data. Two further models, both of which included a third parameter, provided a better fit at the temperature extremes. Close examination of the patterns of variance at different temperatures may provide information relating to the pattern of emergence of aquatic poikilotherms. At temperatures below 23 C, eggs of P. exigua developed more rapidly than eggs of P. constricta, from Henry Lake, Quebec. (Author's abstract)
W90-01319

**LOSS OF SUBMERGED PLANTS WITH EUTROPHICATION: I. EXPERIMENTAL DESIGN, WATER CHEMISTRY, AQUATIC PLANT AND PHYTOPLANKTON BIOMASS IN EXPERIMENTS CARRIED OUT IN PONDS IN THE NORFOLK BROADLAND.**
University of East Anglia, Norwich (England). School of Environmental Sciences.
For primary bibliographic entry see Field 5C.
W90-01320

**LOSS OF SUBMERGED PLANTS WITH EUTROPHICATION: II. RELATIONSHIPS BETWEEN FISH AND ZOOPLANKTON IN A SET OF EXPERIMENTAL PONDS, AND CONCLUSIONS.**
University of East Anglia, Norwich (England). School of Environmental Sciences.
For primary bibliographic entry see Field 5C.
W90-01321

**LOSS OF SUBMERGED PLANTS WITH EUTROPHICATION: III. POTENTIAL ROLE OF ORGANOCHLORINE PESTICIDES: A PALAEOECOLOGICAL STUDY.**
University of East Anglia, Norwich (England). School of Environmental Sciences.
For primary bibliographic entry see Field 5C.
W90-01322

**FILTRATION RATE OF DREISSENA POLYMORPHA (BIVALVIA) IN THREE DUTCH LAKES WITH REFERENCE TO BIOLOGICAL WATER QUALITY MANAGEMENT.**
Instituut voor Cultuurtechniek en Waterhuishouding, Wageningen (Netherlands).
For primary bibliographic entry see Field 5G.
W90-01323

**ADSORPTION AND RELEASE OF AMINO ACIDS FROM EPILITHIC BIOFILMS IN STREAMS.**
Mount Allison Univ., Sackville (New Brunswick). S. M. Armstrong, and F. Barlocher.
Freshwater Biology FWBLAB, Vol. 22, No. 1, p 153-159, August 1989. 4 fig, 29 ref.

Descriptors: *Streams, *Sediments, *Biofilms, *Amino acids, *Adsorption, *Leaves, *Invertebrates, Glycine, Aspartic acid, Lysine, Calcium.

Stream sediment with a natural biofilm generally adsorbed more glycine, aspartic acid, and lysine than sterile sediment. Lysine was adsorbed to a greater extent than the other two amino acids. In the presence of Ca, adsorption of aspartic acid increased and adsorption of lysine decreased. Glycine was not affected. Stream sediment preferentially removed amino acids with a positive charge or a polar R group from maple leaf leachate. It is estimated that stream invertebrates may have access to a maximum of 7.3% of the amino acids present in epilithic biofilms. More amino acids were available from biofilms exposed to leaf leachate. (Author's abstract)
W90-01324

**SIGNIFICANCE OF ADVECTION FOR THE CARRYING CAPACITIES OF FJORD POPULATIONS.**
Bergen Univ. (Norway). Dept. of Marine Biology.
For primary bibliographic entry see Field 2L.
W90-01327

**SCALE-BEARING CHRYSOPHYCEAE (MALLOMONADACEAE AND PARAPHYSOMONADACEAE) FROM MACKENZIE DELTA AREA LAKES, NORTHWEST TERRITORIES, CANADA.**
Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst.
C. McKenzie, and H. King.
Nordic Journal of Botany NJBODK, Vol. 9, No. 1, p 103-112, 1989. 3 fig, 49 ref.

Descriptors: *Limnology, *Chrysophyta, *Lakes, Species composition, Light microscopy, Electron microscopy, Mackenzie Delta, Northwest Territories, Canada.

Scale-bearing Chrysophyceae were examined by means of light, scanning electron, and transmission electron microscopy. Samples were taken from nine arctic lakes in the Mackenzie Delta area of the Northwest Territories, Canada. Seventeen species of the genera Chryosphaerella, Mallomonas, Paraphysomonas, Spiniferomonas and Synura were identified. Included in these species are seven previously unreported from northern Canada and one species reported only in North America. The composition of the chrysophycean flora from the Mackenzie Delta area lakes is compared with that of arctic lakes in the Saqvaqjuac area, Hudson Bay (N.W.T.), Alaskan lakes, and Greenland lakes. (Author's abstract)
W90-01335

**HYDRAULIC GEOMETRY OF STREAMS AND STREAM HABITAT ASSESSMENT.**
Illinois State Water Survey Div., Champaign. Surface Water Section.
For primary bibliographic entry see Field 2E.
W90-01345

**INFLUENCE OF RIPARIAN VEGETATION ON THE FUNCTIONAL ORGANIZATION OF FOUR HONG KONG STREAM COMMUNITIES.**
Hong Kong Univ. Dept. of Zoology.
D. Dudgeon.
Hydrobiologia HYDRB8, Vol. 179, No. 3, p 183-194, July 28 1989. 1 fig, 5 tab, 33 ref, append.

Descriptors: *Riparian vegetation, *Aquatic habitats, *Aquatic insects, *Aquatic populations, *Hong Kong, Diversity, Spatial distribution, Community structure, Density, Statistical analysis, Trophic structure.

Results of a comparison of the functional organization of macroinvertebrate communities in four Hong Kong streams with different riparian vegetation showed only weak agreement with the predictions of the River Continuum Concept (RCC). Shredders were relatively abundant at shaded sites with high detrital standing stocks, while scrapers and piercers (of plant cells) were more numerous in unshaded streams with an autochthonous food base. Abundance of predators and filter-feeders differed little between sites. Collectors were most numerous in the least shaded stream, but their representation was not clearly related to riparian conditions. Multiple regression models indicated that the abundance of shredders and piercers could be explained by the standing stocks of detritus and chlorophylls, and predator abundance was related to the densities of potential prey. Notwithstanding, there was little evidence that interactions between functional groups determined community organization, and trophic structure did not seem to be closely related to the efficiency of energy utilization in the study streams. A comparison of the results of discriminant function analysis, using morphospecies abundance or functional group representation as predictors of site identity, indicated that morphospecies could serve to assign correctly all samples to their stream of origin. However, functional group abundance gave an overall 80-90% correct classification indicating that simplified community structural data can give a good indication of habitat parameters. (White-Reimer-PTT)
W90-01373

**PROPOSAL FOR MODIFICATION OF THE BELGIAN BIOTIC INDEX METHOD.**
Antwerp Univ., Wilrijk (Belgium). Dept. of Biology.
For primary bibliographic entry see Field 5A.
W90-01374

**PRODUCTION ESTIMATES OF THE DOMINANT TAXA OF CHIRONOMIDAE (DIPTERA) IN THE MODIFIED, RIVER WIDAWKA AND THE NATURAL, RIVER GRABIA, CENTRAL POLAND.**
Lodz Univ. (Poland). Inst. of Environmental Biology.
M. Grzybkowska.
Hydrobiologia HYDRB8, Vol. 179, No. 3, p 245-259, July 28 1989. 3 fig, 3 tab, 37 ref.

Descriptors: *Midges, *Aquatic insects, *Water pollution effects, *Mine wastes, *Poland, Oligochaetes, Rivers, Biomass, Productivity, Diversity, Community structure, Dominance.

Production and community composition of selected Chironomidae taxa were estimated in crossections of the lower course of two lowland rivers, the Widawka and the Grabia. At the site sampled the Grabia has not changed its morphometry for many years, whereas the discharge of the Widawka has increased (mainly due to inputs of coal mine water) by 75% compared with its hypothetical natural discharge. The total macrobenthos density in the Grabia amounted to 18,578 indiv./sq m, and that in the Widawka to 7,381 indiv./sq m. Chironomidae and Oligochaeta were dominant in the Widawka (80.7% of the total abundance) and Chironomidae were dominant in the Grabia (57.6% of the total abundance). In the Widawka the production value, for 76.7% of total Chironomidae abundance, amounted to 12.45 g dry wt/sq m/yr, while in the Grabia it amounted to 11.91 g dry wt/sq m/yr. The annual P:B (annual production/standing stock) ranged from 14.5 for large-sized species (Chironomus in the Widawka) to 82.0 for small-sized species (Eukiefferiella in the Grabia). Production values estimated for both rivers, despite a three times higher density of chironomidae in the Grabia, were very similar. (Author's abstract)
W90-01375

**SEMI-AUTOMATIC METHOD TO QUANTIFY AND IDENTIFY ZOOPLANKTON.**
Hydrological Research Inst., Pretoria (South Africa).
M. R. Howard, and C. E. van Ginkel.
Water SA WASADV, Vol. 15, No. 3, p 137-139, July 1989. 3 fig, 1 tab.

Descriptors: *Zooplankton, *Ecosystems, *Aquatic populations, *Sampling, *Quantitative analysis, Aquatic animals, Population density, Computers.

The use of a microfiche reader in counting and identifying zooplankton samples was investigated. The data from the system were logged onto a microcomputer and saved on a diskette. The system was found to increase the number of samples analyzed per unit of time and to increase the time the operator could spend on analyzing the samples, due to reduced eye strain. A number of minor problems encountered with the system included signs of wear in the plastic wheels on the microfiche, which is used to focus on the sampling tray, after the system had been used for only a few months, which make focusing difficult. Large sample volumes allowed the species to move about, causing problems in identification and counting. Nevertheless, costs were kept to a minimum and existing equipment was used. The system is now in everyday use. (Friedmann-PTT)
W90-01402

**ACIDITY AND ALKALINITY OF RESERVOIR WATER IN THE SIERRA NEVADA, CALIFORNIA.**
California Univ., Berkeley. Dept. of Plant and Soil Biology.
For primary bibliographic entry see Field 5B.
W90-01434

**VARIATION OF RIVER DISCHARGES AND LAKE LEVELS IN WEST AFRICA SINCE THE BEGINNING OF THE TWENTIETH CENTURY, (VARIATION DES DEBITS DES COURS D'EAU ET DES NIVEAUX DES LACS EN AFRIQUE DE L'OUEST DEPUIS LE DEBUT DU 20EME SIECLE).**
Comite National Francais des Sciences Hydrologiques, Paris (France).
For primary bibliographic entry see Field 2E.
W90-01539

**LAKE ICE FORMATION AND BREAKUP AS AN INDICATOR OF CLIMATE CHANGE: POTENTIAL FOR MONITORING USING REMOTE SENSING TECHNIQUES.**
Cooperative Inst. for Research in Environmental Science, Boulder, CO.
For primary bibliographic entry see Field 2C.
W90-01551

**CLIMATIC CHANGE AND GREAT LAKES WATER LEVELS.**
Windsor Univ. (Ontario). Great Lakes Inst.
For primary bibliographic entry see Field 2B.
W90-01577

**SENSITIVITY OF WATER RESOURCES IN THE GREAT LAKES REGION TO CHANGES IN TEMPERATURE, PRECIPITATION, HUMIDITY, AND WIND SPEED.**
Canadian Climate Centre, Downsview (Ontario).
For primary bibliographic entry see Field 2B.
W90-01578

**LONG-TERM CHANGES IN WATER QUALITY PARAMETERS OF A SHALLOW EUTROPHIC LAKE AND THEIR RELATIONS TO METEOROLOGIC AND HYDROLOGIC ELEMENTS.**
Akademie der Wissenschaften der DDR, Berlin. Inst. fuer Geographie und Geooekologie.
H. Behrendt, R. Stellmacher, and M. Olberg.
IN: The Influence of Climate Change and Climatic Variability on the Hydrologic Regime and Water Resources, International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication No. 168, 1987. p 535-544, 5 fig, 1 tab, 17 ref.

Descriptors: *Water chemistry, *Climatology, *East Germany, *Eutrophic lakes, Spectral analysis, Hydrobiology, Seston, Chemical oxygen demand, Chlorides, Oxygen, Temperature, Future planning.

Changes of climatologic conditions influence not only hydrophysical, but also hydrochemical and hydrobiological parameters of a water body. These parameters of water quality are connected with meteorologic and hydrologic factors directly or indirectly. Time series were collected from Lake Muggelsee, the main reservoir for the drinking water supply of Berlin, GDR. Long-term changes of the following water quality parameters of this shallow eutrophic lake and meteorologic and hydrologic elements were analyzed by statistical methods: total seston content, chemical oxygen demand, chloride concentration, oxygen content and water temperature of Lake Muggelsee, discharge of the river Spree at Beeskow, global radiation in Potsdam and sum of negative daily mean temperature in Berlin. One-channel and multichannel auto regressive spectral analyses are used to check the spectral behavior of these parameters respectively. For the time period 1946-1984 the following periodicities were detected: Short periods between 2 and 3.5 yrs, middle periods at 5 yrs and long periods between 12 and 20 yrs. (See also W90-01537) (Author's abstract)

W90-01582

**IMPACT OF INCREASING ATMOSPHERIC CARBON DIOXIDE CONCENTRATIONS UPON RESERVOIR WATER QUALITY.**
Salford Univ. (England). Dept. of Mathematics and Computer Science.
For primary bibliographic entry see Field 2B.
W90-01585

**STORAGE RESERVOIRS FOR WATER SUPPLY OF ECOLOGICAL IMPORTANCE.**
Gelsenwasser A.G., Gelsenkirchen (Germany, F.R.).
For primary bibliographic entry see Field 5F.
W90-01632

**LAKES REMAINING FROM GRAVEL EXCAVATIONS FOR RECREATIONAL AND SPORTS USE IN LARGE CITIES.**
Zagreb Univ. (Yugoslavia).
For primary bibliographic entry see Field 3D.
W90-01691

**WETLAND MANAGEMENT IN THE CONTEXT OF REGIONAL PLANNING, EAST CALCUTTA--A CASE STUDY.**
For primary bibliographic entry see Field 5G.
W90-01698

**MULTI-PURPOSE, MULTI-RESERVOIR SIMULATION ON A PC.**
Hydrologic Engineering Center, Davis, CA.
B. S. Eichert, and C. Franks.
Available from the National Technical Information Service, Springfield, VA 22161 as AD-A198 748. Price codes: A03 in paper copy, A01 in microfiche. Technical Paper No. 119, August 1988. 20p, 5 fig, 10 ref.

Descriptors: *Reservoir operation, *Simulation analysis, *Computer programs, Computers, Model studies, Data interpretation, Computer models.

The methodology and difficulties in converting a large, general purpose, mainframe, batch oriented computer program (for reservoir simulation) to work effectively in the PC environment are described in this paper. A brief overview of the present capabilities of the general purpose reservoir simulation program (HEC-5), that works on mainframe and MS DOS compatible computers, is also presented. Major aspects of the conversion to the PC environment are presented, including the transformation of large subroutines written in FORTRAN IV, to a modular style in FORTRAN-77. Experience with various Fortran compilers and techniques for memory management (considering the limited memory space available on the PC) are also presented. Overlaying and memory caching, used as implementation techniques for the PC, are discussed. Discussion includes using extended memory on the PC, which allows the program to operate in a non-overlaid form at speeds comparable to the HARRIS-1000 super minicomputer. Results showing the performance of the program as related to the HARRIS-1000 and various PC's are shown. The recent enhancements to provide interactive execution of various utility programs for HEC-5 are discussed. These programs include: checking input data (CKHEC5); interactive input preparation (INFIVE); input modification (MODFIV); handling program executions (MENU5); and interactive output displays from HEC-5. Special 'user friendly' features depicting spatial displays of input data and simulation results are shown. (Lantz-PTT)
W90-01725

**CHEMICAL CHARACTERISTICS OF STREAMS IN THE MID-ATLANTIC AND SOUTHEASTERN UNITED STATES (NATIONAL STREAM SURVEY-PHASE I). VOLUME II: STREAMS SAMPLED, DESCRIPTIVE STATISTICS, AND COMPENDIUM OF PHYSICAL AND CHEMICAL DATA.**
Environmental Protection Agency, Washington, DC. Office of Acid Deposition, Environmental Monitoring, and Quality Assurance.
For primary bibliographic entry see Field 7B.
W90-01728

**ALGAE FLUORESCENCE TEST AS A SENSITIVE BIOTEST ON ALGICIDE SUBSTANCES IN SURFACE WATER (ALGEN-FLUORESZENZTEST ALS EMPFINKLICHER BIOTEST AUF ALGIZIDE SUBSTANZEN IM OBERFLAECHENWASSER).**
Umweltbundesamt, Berlin (Germany, F.R.).
For primary bibliographic entry see Field 5A.
W90-01730

## 2I. Water In Plants

**TRANSPIRATION OF MATURE STANDS OF SPRUCE (PICEA ABIES (L.) KARST.) AS ESTIMATED BY THE TREE-TRUNK HEAT BALANCE METHOD.**
Vysoka Skola Zemedelska, Brno (Czechoslovakia). Inst. of Forest Ecology.
For primary bibliographic entry see Field 4D.
W90-01461

**ESTIMATING WATER USE BY EUCALYPTUS GRANDIS WITH THE PENMAN-MONTEITH EQUATION.**
South African Forestry Research Inst., Sabie.
For primary bibliographic entry see Field 2D.
W90-01463

**SEASONAL VARIATION OF RADIATION AND ENERGY BALANCES IN A HINOKI STAND.**
Forest and Forest Products Research Inst., Kyoto (Japan). Kansai Branch.
For primary bibliographic entry see Field 2D.
W90-01464

**USE OF LYSIMETER MEASUREMENTS FOR ESTIMATION OF THE EVAPOTRANSPIRATION OF PINE FOREST BY BAGROV'S METHOD.**
Humboldt-Univ. zu Berlin (German D.R.). Sektion Physik.
For primary bibliographic entry see Field 2D.
W90-01465

**SOIL WATER BALANCE MODEL FOR PARTITIONING WATER USE AMONG CROP TREES, EVAPORATION, AND COMPETING VEGETATION.**
Oregon State Univ., Corvallis. Dept. of Soil Science.
For primary bibliographic entry see Field 2G.
W90-01468

## 2J. Erosion and Sedimentation

**EVALUATION OF HYDROLOGICAL AND BIOLOGICAL INFLUENCES ON CO2 FLUXES FROM A KARST STREAM.**
Virginia Univ., Charlottesville. Dept. of Environmental Sciences.
For primary bibliographic entry see Field 2E.
W90-01025

**APPLICATION OF A DIGITAL FILTER FOR MODELLING RIVER SUSPENDED SEDIMENT CONCENTRATIONS.**
Geneva Univ. (Switzerland). Inst. F.-A. Forel.
L. Zhang, D. J. Gregor, and J.-P. Vernet.
Journal of Hydrology JHYDA7, Vol. 108, No. 1-4, p 267-279, Jun 1989. 4 fig, 1 tab, 12 ref.

Descriptors: *Model studies, *Rivers, *Suspended sediments, *Mathematical models, *Simulation, *Computer models, *Digital filter method, Stream discharge, Storms, Venoge River, Switzerland.

The relationship between suspended sediment concentration and discharge in a river system is the result of a complex interaction of factors within the basin and of specific storm events. Nevertheless, estimation of suspended sediment concentrations during storm events is essential for prediction of loadings from storm-controlled river basins to the receiving waters. The Venoge River, a tributary of Lake Geneva, Switzerland, with a basin area of 237 sq km, was monitored during 8 storm events between October 1986 and November 1987. A digital filter was used to simulate the suspended sediment response during individual events with the principal factors being antecedent flow, maximum discharge and time during which maximum flow was attained. The measured and calculated sediment concentration curves were assessed using a chi-square test. The two curves were similar in shape at 95% confidence interval. However, the model is not always capable of simulating the phase lead effect of the sediment distribution curve relative to the hydrograph. This problem is most evident during high-intensity storms at periods of low base flow; consequently, loadings calculated for individual storms of this type could be overestimated. Fortunately, the model provides good predictions during less-intense, longer-duration events and therefore loadings calculated by summing events for an annual period will tend not to be overestimated. Further work is necessary to evaluate the model for additional events, in particular spring snow melt, and to determine its applicability to other river systems. (Author's abstract)
W90-01030

**TIME-SPACE HETEROGENEITY IN THE SEDIMENTS OF THE RICE FIELDS FROM THE EBRO DELTA (NE SPAIN) (HETEROGENEIDAD ESPACIOTEMPORAL DEL SEDIMENTO DE LOS ARROZALES DEL DELTA DEL EBRO (NE DE ESPANA)).**
Barcelona Univ. (Spain). Dept. de Ecologia.
For primary bibliographic entry see Field 2H.
W90-01059

**EXPERIMENTS ON THE THICKNESS OF BEDS DEPOSITED BY TURBIDITY CURRENTS.**
McMaster Univ., Hamilton (Ontario). Dept. of Geology.
G. V. Middleton, and W. J. Neal.
Journal of Sedimentary Petrology JSEPAK, Vol. 59, No. 2, p 297-307, March 1989. 11 fig, 3 tab, 19 ref. National Science and Engineering Research Council of Canada grants.

Descriptors: *Turbidity currents, *Sedimentation, *Sedimentary structures, *Bed load, Flow channels, Flow characteristics, Particle size, Sediment sorting, Sediment concentration, Suspended sediments, Locks, Channels, Settling velocity, Water currents, Regression analysis.

Deposition of sand from turbidity currents is a common mode of origin of sedimentary beds, called 'turbidites.' Turbidites were produced experimentally by releasing suspensions of spherical beads from a lock into a horizontal channel. Flow properties were varied by changing initial flow geometry (using two lock lengths and four depths), and sediment size (four sizes of beads), sorting (mixing bead sizes and types), and concentration (20 and 40% by volume) in the initial suspension. Bed thickness was almost uniform near the source except for beds deposited from poorly sorted sediment suspensions, which tend to be wedge-shaped. High concentration produced more uniform bed thickness, and shorter, thicker beds. Increases in lock height and length increased bed thickness almost equally. If all other variables were held constant, bed thickness was directly proportional to grain size. The dimensionless ratio of the square of bed thickness divided by the volume of suspension was found to be directly proportional to the dimensionless ratio of settling velocity divided by the speed of the head of the current. The 'constant' in the regression equation appears to depend mainly on the sediment concentration. The experimentally determined equation gives plausible values for turbidity current velocities when extrapolated to scales over a million times larger than those of the experiments. (Author's abstract)
W90-01099

**OBSERVED PARAMETERS FOR TURBIDITY-CURRENT FLOW IN CHANNELS, RESERVE FAN, LAKE SUPERIOR.**
National Bureau of Oceanography, Qingdao (China). First Inst. of Oceanography.
W. R. Normark.
Journal of Sedimentary Petrology JSEPAK, Vol. 59, No. 3, p 423-431, May 1989. 3 fig, 3 tab, 17 ref.

Descriptors: *Mine wastes, *Lake Superior, *Turbidity currents, *Sediment transport, *Deltas, *Channel flow, *Lake sediments, Current meters, Flowmeters, Flow velocity, Flow measurement, Channel morphology, Submarine canyons, Sedimentary structures, Mine wastes, Particle size, Flow characteristics, Industrial wastes, Minnesota.

Fine-grained tailings discharged from a taconite-ore processing operation near the shore of Lake Superior produced turbidity currents that transported the sediment from a small delta into deep water at Silva Bay, Minnesota. Deposition over nearly 20 years produced a sublacustrine fan with two prominent channels. During 1972 and 1973, a current meter anchored five meters above the lake floor adjacent to one of the channels recorded episodic turbidity-current flow events lasting as long as two weeks. To understand flow parameters for turbidity currents better, a short-term experiment within a channel on Reserve Fan in 1975 measured those variables not previously directly observed for channelized turbidity currents: flow thickness, flow density, and concurrent velocity. The observed flow thickness, approximately 16 meters, is nearly four times the channel depth. Calculations using the average flow speeds (eight to twelve centimeters per second) and the dilute concentration of the flow as measured during the experiment yield a value for the drag coefficient that is in remarkable agreement with estimated values commonly used for deriving speeds of turbidity currents using dimensions of submarine channels and properties of the sediments. (Author's abstract)
W90-01100

**TIDAL CURRENT RIDGES IN THE SOUTHWESTERN YELLOW SEA.**
National Bureau of Oceanography, Qingdao (China). First Inst. of Oceanography.
For primary bibliographic entry see Field 2L.
W90-01101

**STORM-DOMINATED SEDIMENTATION ON THE INNER SHELF OF THE CANADIAN BEAUFORT SEA.**
Bedford Inst. of Oceanography, Dartmouth (Nova Scotia). Atlantic Geoscience Centre.
P. R. Hill, and O. C. Nadeau.
Journal of the Institution of Water and Environmental Management, Vol. 3, No. 3, p 455-468, June 1989. 13 fig, 1 tab, 26 ref.

Descriptors: *Continental shelf, *Coastal waters, *Canada, *Sedimentation, *Storms, *Fluvial sediments, Suspended sediments, Waves, Tides, Water currents, Physiographic balance, Particle size, Sand, Silt, Wave action, Water depth, Wave height.

Sedimentation on the inner shelf of the Canadian Beaufort Sea results from a complex interaction of sediment supply, fluvial discharge, waves, tides, currents, and physiography. The inner shelf is characterized by a succession of near-surface fine-grained facies changes. Seaward of shoreface sands and silts, these facies are related to wave action at the seabed. The massive to graded medium to thick-bedded facies occurs between water depths of 4.2 and 5.5 meters and is interpreted to result from resuspension events by waves during storms. A nearbed region of suspended sediment concentration (SSC), observed near the five-meter isobath, increased in concentration during moderate storms. Time series of nearbed SSC and wave heights in 5.9 meters of water recorded rapid resuspension resulting in SSC values of 4,000 milligrams per liter during a severe storm. The thin-bedded silt and clay facies found shoreward of this resuspension zone is interpreted to result from attenuation of wave energy in the resuspension zone. The amount of resuspension decreases shoreward, resulting in thinner redeposited beds. Seaward of the resuspension zone, the frequency of bottom resuspension decreases with increasing water depth, reflecting the lower frequency of very large storm waves. This is reflected in the deeper water facies where bioturbated clay becomes the dominant facies, with thin silt beds representing infrequent bottom resuspension during the largest storms. (Author's abstract)
W90-01102

**ESTIMATION OF THE SURFACE RUNOFF AND ITS SUSPENDED LOAD IN SOME MAJOR WORLD RIVER BASINS (ESTIMATION DE L'ECOULEMENT SUPERFICIEL ET DE SA CHARGE EN SUSPENSION SUR QUELQUES GRANDS BASSINS FLUVIAUX DU MONDE).**
Centre National de la Recherche Scientifique, Strasbourg (France). Centre de Sedimentologie et de Geochimie de la Surface.
For primary bibliographic entry see Field 2E.
W90-01174

**DETERMINATION OF DI- AND TRIBUTYLTIN IN SEDIMENT AND MICROBIAL BIOFILMS USING ACIDIFIED METHANOL EXTRACTION, SODIUM BOROHYDRIDE DERIVATIZATION AND GAS CHROMATOGRAPHY WITH FLAME PHOTOMETRIC DETECTION.**
Maryland Univ., College Park. Dept. of Chemistry and Biochemistry.
For primary bibliographic entry see Field 5A.
W90-01280

**MASS TRANSPORT VELOCITY IN MUD LAYER DUE TO PROGRESSIVE WAVES.**
Central Research Inst. of Electric Power Industry, Chiba (Japan).
T. Sakakiyama, and E. W. Bijker.
Journal of Waterway, Port, Coastal and Ocean Engineering (ASCE) JWPED5, Vol. 115, No. 5, p 614-633, September 1989. 15 fig, 1 tab, 11 ref, append.

Descriptors: *Silting, *Sediment transport, *Mud, *Wave action, *Mud-water interfaces, *Channel accretion, *Harbors, *Sedimentation, Mass transfer, Hydrodynamics, Kaolinite, Linear programming, Shear tests, Shear stress, Model testing, Viscosity.

The dynamics of soft mud layers due to waves is of great importance for sedimentation processes in approach channels and harbors. The mass transport in the mud layer is described both theoretically and experimentally. The theoretical model to estimate the mud mass transport is developed on the basis of the linear wave theory and of Newtonian fluid. The experiments are performed by using the mixture of kaolinite and water, which behaves like a Bingham fluid. The present experimental results show the nonlinearities of the mass transport in the mud layer and of the attenuation of the surface mud height, which are due to the relationship between shear stress and shear rate of the mud. These are discussed through the comparison with the results by the model. It is also found that the present model can be used to evaluate the mud mass transport by giving it a pertinent apparent viscosity of mud, which is estimated by the shear rate in the orbital motion. (Author's abstract)
W90-01341

**IN SITU ACOUSTIC MEASUREMENTS OF MARINE GRAVEL THRESHOLD AND TRANSPORT.**
Proudman Oceanographic Lab., Birkenhead (England).
P. D. Thorne, J. J. Williams, and A. D. Heathershaw.
Sedimentology SEDIAT, Vol. 36, No. 1, p 61-74, February 1989. 10 fig, 2 tab, 36 ref.

Descriptors: *Turbulent flow, *Bed-load discharge, *Sediment transport, *Instrumentation, *Flow measurement, *Gravel, *Acoustics, Vertical flow, Flow characteristics, Reynolds number, Tidal hydraulics, Boundary layers, Current meters, Particle size, Cameras, Sampling, Velocity, Shear stress.

Measurements of the nearbed turbulent current flow and the bed load transport of marine gravel have been made over three tidal cycles, in order to better investigate the turbulent horizontal and vertical flow components together with the instantaneous Reynolds stresses above a gravel bed. The turbulence in the bottom boundary layer was measured using two electromagnetic current meters, and the gravel transport was measured using a passive acoustic system which monitored the interparticle collision noise of locally mobile material. Visual estimates of bed load were also obtained with an underwater TV camera. The acoustic technique, unlike a conventional bed load sampler, has allowed estimates of transport to be obtained with a temporal resolution comparable with the turbulence data collected. This has enabled a detailed comparison to be made between the turbulent flow and the sediment response to the instantaneous flow conditions. The results of the study show that of the turbulent bursting events which contribute towards the Reynolds stress, only the sweeps and outward interactions play a significant role in the transport of coarse sedimentary material. The measurements show that it is the instantaneous increases in the horizontal turbulent velocity fluctuations that generate excess shear stresses which drive the transport process. (Author's abstract)
W90-01357

**DEPOSITIONAL PROCESSES ON AN ANCIENT AND MODERN MUDDY SHELF, NORTHERN CALIFORNIA.**
Washington Univ., Seattle. Dept. of Geological Sciences.
E. L. Leithold.
Sedimentology SEDIAT, Vol. 36, No. 2, p 179-202, April 1989. 16 fig, 2 tab, 64 ref.

Descriptors: *Paleosedimentology, *Sedimentation, *Deposition, *Mud, *Aquatic environment, *Sediment distribution, River systems, Floods, Flood discharge, Coastal plains, Storms, Clays, Silt, Silting, Sediment transport, Sedimentary structures, Particle size, California.

The modern Eel River shelf and analogous Pleistocene Rio Dell Formation in northern California provide an ideal opportunity to combine the advantages of studying a modern environment with those of studying an ancient sequence, and thereby enables further understanding of muddy-shelf processes. Both large-scale sediment distribution patterns and small-scale stratigraphy on the shelf indicate that river floods play an important role in sediment accumulation, even on a high-energy, 'storm-dominated' coast. Detailed examination of the Rio Dell Formation deposits provides insight into the nature and role of various processes on both the ancient and modern shelf. Muddy facies of the Rio Dell sequence are characterized by bioturbated, clayey silts, interbedded with event layers of several types. Clay-rich silt layers are interpreted as flood deposits and physically stratified, coarse-silt layers are interpreted to record transport and deposition of coarse silt on the mid-shelf during storms. Sediment transport calculations and consideration of grain-size distributions of bioturbated sediments, which form the bulk of the Rio Dell sequence, suggest that these sediments are the result of biological homogenization of the fine-grained flood deposits and of the coarser-grained storm deposits. The results of this study in general indicate that fine-grained shelf deposits do preserve a distinguishable, if subtle, record of depositional processes. (Author's abstract)
W90-01358

**BEDLOAD TRANSPORT OF MUD AS PEDOGENIC AGGREGATES IN MODERN AND ANCIENT RIVERS.**
Ottawa Univ. (Ontario). Dept. of Geology.
B. R. Rust, and G. C. Nanson.
Sedimentology SEDIAT, Vol. 36, No. 2, p 291-

306, April 1989. 10 fig, 62 ref.

Descriptors: *Paleosedimentology, *Sedimentation, *Mud, *Aggregates, *Bed-load discharge, *Sediment transport, Flood plains, Clays, Climates, Soil environment, River wash, Paleosols, Paleoclimatology, Paleohydrology, Connecticut, Canada, Australia.

Most fluvial systems transport mud in suspension. Abundant sand-sized mud aggregates in the Cooper and Diamantina Rivers, Lake Eyre Basin, Australia, are attributed to bed load transport of aggregates formed in deeply-cracked floodplain soils. The conditions required for formation of pedogenic mud aggregates are: (1) abundant clay containing at least minor swelling clay, and (2) a climate with at least seasonally hot dry periods. The worldwide distribution of these soils (vertisols) suggests that a significant amount of mud is transported as pedogenic aggregates by modern rivers. Ancient analogs in which mud aggregates and vertisol profiles have been recognized are the Jurassic East Berlin Formation (Connecticut) and the Carboniferous Maringouin Formation (New Brunswick and Nova Scotia, Canada). The dominant red mudstones of these formations are interpreted as mainly bed load sediments deposited by sheet floods in semi-arid paleoclimates. The Triassic Hawkesbury Sandstone (NSW, Australia) also contains sand-sized mudstone aggregates, thought to be pedogenic, but its paleosol and other facies point to formation in a wetter paleoclimate. The indications are that bed load transport of mud as pedogenic aggregates was as significant a process in ancient rivers as it is at present. (Author's abstract)
W90-01359

**SEDIMENTOLOGY AND ORIGIN OF DEPOSITS FROM A SMALL ICE-DAMMED LAKE, LEIRBREEN, NORWAY.**
ARC Western Ltd., Shrewsbury (England).
R. Donnelly, and C. Harris.
Sedimentology SEDIAT, Vol. 36, No. 4, p 581-600, August 1989. 21 fig, 1 tab, 41 ref.

Descriptors: *Sedimentation, *Glaciohydrology, *Glacial lakes, *Glacial sediments, *Lake sediments, *Iced lakes, Sedimentary structures, Ripple marks, Sand, Silt, Water circulation, Sediment distribution, Seasonal variation, Ice pressure, Compressive strength, Deformation, Icebergs, Norway.

Recently, proglacial lacustrine sediments were exposed by the drainage of a small ice-dammed lake basin at Leirbreen, central Jotunheimen, Norway. The dominant facies include ripple-laminated, massive and horizontally-stratified sands, massive and horizontally-laminated silts, and irregularly-laminated fine sands and silts. The major control on lake circulation and the nature and distribution of these facies was an underflow driven by a subglacial meltwater stream which formed the major lake input. Although much of the sedimentary sequence indicates a pulsatory input, the proximal character of this small lake prevented the development of classic varved silts. Compressional deformation of shoreline sediments was due to winter lake ice push. Other deformational processes included the grounding of icebergs, water escape and syn-sedimentary downslope collapse. Observations from an adjacent small ice-marginal lake at Leirbreen provide support for several of the inferences drawn from the sediments of the former ice-dammed lake. (Author's abstract)
W90-01360

**COMPARISON OF TWO GRAVITY CORING DEVICES FOR SEDIMENTATION RATE MEASUREMENT BY PB210 DATING TECHNIQUES.**
Washington Univ., Seattle. Lab. of Radiation Ecology.
A. E. Nevissi, G. J. Shott, and E. A. Crecelius.
Hydrobiologia HYDRB8, Vol. 179, No. 3, p 261-269, July 28 1989. 4 fig, 2 tab, 17 ref.

Descriptors: *Samplers, *Lead isotopes, *Core samplers, *Cores, *Sedimentation rates, *Sampling, *Radioactive dating, Puget Sound, Sediment depth, Core shortening, Cross-calibration, Coring devices.

Marine sediment cores were collected in Puget Sound using a 7.6 cm diameter corer and a 15 x 15 cm square cross-section corer. The cores were dated by the Pb210 method and sedimentation rates and depth of sediment mixed layers were compared. The shortening of sediment cores is an artifact of coring processes and occurs to some extent in almost any type of coring device. The core shortening affects the sediment rate measurements and it is independent of any dating model used. The results show that the sedimentation rates and the depth of sediment mixed layers obtained from the small diameter corer are 2-3 times smaller that the corresponding values obtained for large cross-section corer. The large diameter corer also induces core shortening and distortion of sedimentation rate that can be measured against a third corer. A cross-calibration of coring techniques seems necessary to correlate sedimentation rates obtained using different devices. (Author's abstract)
W90-01376

**RUNOFF AND EROSION IN CLEARINGS FOLLOWING CUTTING OF THE HUMID TROPICAL FOREST (ECOULEMENTS ET EROSION SOUS PRAIRIES ARTIFICIELLES APRES DEFRICHEMENT DE LA FORET TROPICALE HUMIDE).**
Office de la Recherche Scientifique et Technique Outre-Mer, Cayenne (French Guiana).
For primary bibliographic entry see Field 4C.
W90-01443

**TEST OF AN ERODIBILITY RATING SYSTEM FOR THE FOOTHILLS OF CENTRAL ALBERTA, CANADA.**
National Agrarian Univ., Lima (Peru). Dept. Manejo Forestal.
C. A. Llerena, H. Zhang, and R. L. Rothwell.
IN: Forest Hydrology and Watershed Management. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication No. 167, 1987. p 155-161, 3 fig, 1 tab, 15 ref.

Descriptors: *Erosion hazards, *Soil erosion, *Forest hydrology, *Infiltration rate, Erosion rates, Model studies.

A proposed method of erosion hazard rating, based on infiltration rates of forest cover-soil associations as erodibility indicators, was assessed against measured soil loss using natural and artificial rainfall. Both testing methods indicated similar rates of erosion for the forest cover-soil associations tested. Comparison of the erosion hazard-ranked areas to those ranked on measured erosion showed poor agreement. (See also W90-01432) (Author's abstract)
W90-01446

**PERFORMANCE OF GULLY EROSION CONTROL MEASURES IN SOUTHEASTERN NIGERIA.**
Nigeria Univ., Nsukka. Dept. of Geology.
For primary bibliographic entry see Field 4D.
W90-01447

**POSSIBLE HYDROLOGICAL AND GEOMORPHOLOGICAL CHANGES DUE TO ALTERATION OF FOREST.**
Kyoto Univ. (Japan).
For primary bibliographic entry see Field 4C.
W90-01448

**RECOVERY OF A NEW MEXICO DRAINAGE BASIN FROM A FOREST FIRE.**
New Mexico State Univ., Las Cruces. Dept. of Civil Engineering.
S. Bolin, and T. J. Ward.
IN: Forest Hydrology and Watershed Management. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication No. 167, 1987. p 191-198, 4 fig, 1 tab, 5 ref.

Descriptors: *Soil erosion, *Forest hydrology, *Erosion, *Forest fires, *Suspended sediments, New Mexico, Catchment areas, Runoff.

New Mexico is a semiarid state with essentially all surface water originating as runoff from forested drainage basins. When these basins are disturbed by natural or manmade events, a vital part of the state's water resource is affected. In 1977, a fire burned 60% of 45.33 sq km forested basin in northern New Mexico. Following the fire, water discharge was high and erratic. Peak flow was 100 times greater than the pre-fire levels. Suspended sediment concentrations immediately following the fire were as high as 98,800 mg/L. Two yrs after the fire, peak sediment concentrations dropped to < 600 mg/L. In the first two yrs after the fire, an estimated 23 290 tons of sediment were removed from the basin compared to 10 tons over the next two yrs. Analyses showed that the sediment yield began as a transport-limited phenomenon, but eventually returned to a more typical supply-limited situation. (See also W90-01432) (Author's abstract)
W90-01450

**INFILTRATION AND REDISTRIBUTION OF OVERLAND FLOW AND SEDIMENT ON A LOW RELIEF LANDSCAPE OF SEMI-ARID, TROPICAL QUEENSLAND.**
James Cook Univ. of North Queensland, Townsville (Australia). Dept. of Geography.
For primary bibliographic entry see Field 2E.
W90-01451

**EFFECT OF DIFFERENT TYPES OF FOREST MANAGEMENT ON THE TRANSFORMATION OF RAINFALL ENERGY BY THE CANOPY IN RELATION TO SOIL EROSION.**
Silsoe Coll. (England). Dept. of Field Engineering.
For primary bibliographic entry see Field 4D.
W90-01452

**STUDIES ON THE HYDROLOGICAL PROCESSES IN THE FOREST DRAINAGE BASINS OF THE WESTERN GHATS OF INDIA.**
Centre for Water Resources Development and Management, Calicut (India).
For primary bibliographic entry see Field 4C.
W90-01453

**AMOUNT OF RUNOFF AND SOIL LOSSES FROM VARIOUS LAND-USE SAMPLING PLOTS IN SAKOLNAKORN PROVINCE, THAILAND.**
For primary bibliographic entry see Field 4C.
W90-01454

**DEFORESTATION AND EROSION IN THE NEPALESE HIMALAYA--IS THE LINK MYTH OR REALITY.**
Land Capability Consultants Ltd., Cambridge (England).
W. J. H. Ramsay.
IN: Forest Hydrology and Watershed Management. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication No. 167, 1987. p 239-250, 1 tab, 49 ref.

Descriptors: *Deforestation, *Soil erosion, *Himalayan Mountains, *Nepal, *Erosion, Landslides, Reviews, Sediments.

Despite numerous popular accounts, data on erosion processes in the Himalaya are scarce and unreliable. Quantitative studies of mass wasting and surface erosion in Nepal are reviewed. The literature reveals a consensus that in Nepal erosion rates are naturally very high, mass wasting is the dominant hillslope process, and geological factors are the most important determinants of slope stability. Deforestation is linked to surface erosion, gullying and shallow (< or = 3 m deep) landslides. Locally this soil loss is important agriculturally.

Currently there is no evidence to link deforestation to the large, complex slope failures which mobilize most sediment. (See also W90-01432) (Author's abstract)
W90-01455

**GEOMORPHIC AND VEGETATIVE RECOVERY PROCESSES ALONG MODIFIED TENNESSEE STREAMS: AN INTERDISCIPLINARY APPROACH TO DISTRIBUTED FLUVIAL SYSTEMS.**
Geological Survey, Nashville, TN.
For primary bibliographic entry see Field 6G.
W90-01456

**REFORESTATION: ON-SITE EFFECTS ON HYDROLOGY AND EROSION, EASTERN RAUKUMARA RANGE, NEW ZEALAND.**
New Zealand Forest Service, Rotorua. Forest Research Inst.
For primary bibliographic entry see Field 4C.
W90-01477

**SIMULATION OF WATER FLOW AND SOIL EROSION PROCESSES WITH A DISTRIBUTED PHYSICALLY-BASED MODELLING SYSTEM.**
Dansk Hydraulisk Inst., Hoersholm.
B. Storm, G. H. Jorgensen, and M. Styczen.
IN: Forest Hydrology and Watershed Management. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication No. 167, 1987. p 595-608, 7 fig, 17 ref.

Descriptors: *Soil erosion, *Model studies, *Rainfall-runoff relationships, *Runoff, *Surface flow, *Hydrologic models, Splash detachment, Sediment transport, SEM/SHE model, Hydrographs, Deposition.

A new soil erosion model (SEM) which has been developed based on a physical description of the involved processes is described. The SEM model includes the processes of splash detachment of soil by rainfall, net transport of detached soil by overland flow, overland flow detachment and net transport, and net erosion/deposition within each model grid square. SEM has been incorporated as a separate component in the physically-based, distributed hydrological modelling system SHE. The SEM/SHE model complex has been tested on a small research catchment with an area of 5.6 ha in the United States, and applied to two upland catchments in Thailand of 45 sq km and 138 sq km. Agreement between the simulated and observed hydrographs and sediment yield were good. One of the strengths of the SEM/SHE system is the ability to display spatial and temporal quantities such as the phreatic surface level and net erosion/deposition. (See also W90-01432) (Author's abstract)
W90-01488

**CRITICAL PRECIPITATION CONDITIONS FOR LANDSLIDE AND TREE RING RESPONSES IN THE ROKKO MOUNTAINS, KOBE, JAPAN.**
Kobe Univ. (Japan). Graduate School of Science and Technology.
K. Kashiwaya, T. Okimura, and T. Kawatani.
IN: The Influence of Climate Change and Climatic Variability on the Hydrologic Regime and Water Resources, International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication No. 168, 1987. p 191-197, 7 fig, 7 ref.

Descriptors: *Rainfall variability, *Paleohydrology, *Climatology, *Landslides, *Dendrochronology, Debris flows, Spectral analysis, Japan.

Heavy rainfall in the vicinity of the Rokko Mountains, Kobe, can cause landslides and debris flows. Analysis of the annual summation of heavy rainfall (over 100 mm/da) shows that the rainfall has dominant periodicities at about 30, 10-13 and 5-7 yrs, and that the maximum yrs of a harmonic function with the periods correspond with severe landslides and debris flows. Analytical results of tree rings in the district indicate that the sequences of the tree ring width have a dominant periodicity of around 30 yrs. Cross spectral analysis between the rainfall and the ring width shows high coherency in the periodicity of about 30 yrs. (See also W90-01537) (Author's abstract)
W90-01554

**IMPACT OF CLIMATE CHANGE ON THE MORPHOLOGY OF RIVER BASINS.**
For primary bibliographic entry see Field 2E.
W90-01565

**IS THE LARGEST NORTH AMERICAN SUBARCTIC SAND DUNE DISAPPEARING.**
Saskatchewan Research Council, Saskatoon.
J. Whiting, and E. Wheaton.
IN: The Influence of Climate Change and Climatic Variability on the Hydrologic Regime and Water Resources, International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication No. 168, 1987. p 339-353, 5 fig, 19 ref.

Descriptors: *Climatology, *Geomorphology, *Dunes, *Sand, *Saskatchewan, *Aeolian soils, *Aeolian deposits, Climates, Geology, Hydrology, Geohydrology, Anthropogenic effects, Parabolic dunes, Groundwater, Geologic fractures.

The Athabasca Sand Dunes in northern Saskatchewan are the largest active dune complex in Arctic North America and the largest area of open sand in the world at this northern latitude. The aeolian environment is controlled by climatic, geologic, morphologic, hydrologic, geohydrologic, pedologic, botanic, zoologic, anthropogenic and temporal factors. Each of these factors acts through a number of attributes which interact with one another. While such interactions of various factors are complex, a number of elements dominate in this area. Parabolic dunes develop in this area from moist sand. The oldest dunes are oriented to the south and are stabilized with a northwesterly orientation. This orientation is counter to the presently occurring westerly winds. The newer dunes are in an easterly alignment. The difference in orientation and level of groundwater has been related to the horst and graben features of the underlying Sandstone bedrock. In response to lowering of the level of Lake Athabasca, the rivers have become entrenched and angulated. The present level of Lake Athabasca straddles a fault block step which is not horizontal. The present active dunes are located against the rise of the fault step and are some 70-100 m thick. The sand dune complex is in an uneasy equilibrium between the combined erosive action of the wind and water on one hand and the stabilizing actions of groundwater and vegetation on the other hand. Man has also induced changes with the introduction of hydro-electric dams hundreds of km away, starting forest fires on and near the dunes and driving vehicles over the dunes. (See also W90-01537) (Author's abstract)
W90-01567

**TRANSPORT OF SUSPENDED SOLIDS IN SEWERS.**
Witteveen and Bos, Deventer (Netherlands).
For primary bibliographic entry see Field 5D.
W90-01636

**HYDROLOGICAL IMPACT OF URBANIZATION--A STUDY OF THE PALMIET RIVER IN METROPOLITAN DURBAN, SOUTH AFRICA.**
Durban-Westville Univ. (South Africa). Dept. of Geography.
For primary bibliographic entry see Field 4C.
W90-01676

**MULTICOMPARTMENT MODEL OF SUSPENDED MATTER TRANSPORT IN SURFACE BODIES OF WATER (MULTIKOMPARTIMENT-MODELL FUR DEN TRANSPORT VON STOFFEN IN OBERFLAECHENGEWAESERN).**
Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.). Projektgruppe Umweltgefaehrdungsponteniale von Chemikalien.
For primary bibliographic entry see Field 5B.
W90-01775

**COOPERATION FOR RECREATION AND STREAMBANK RETENTION--THE TIOGA COUNTY EXPERIENCE.**
Tioga County Planning Board, Oswego, NY.
For primary bibliographic entry see Field 4D.
W90-01926

## 2K. Chemical Processes

**SIMPLE FLUORIMETRIC DETERMINATION OF ENZYMATIC ACTIVITIES IN VIVO AND OF THE BIOMASS (DNA) ON MICROTITER PLATES (RATIONELLE FLUORIMETRISCHE BESTIMMUNG VON ENZYMAKTIVITATEN IN VIVO UND DER BIOMASSE (DNA) AUF MIKROTITERPLATTEN).**
Wasserforschung Mainz G.m.b.H. (Germany, F.R.).
For primary bibliographic entry see Field 7B.
W90-00988

**NUTRIENT STATUS OF THE SUNDAYS RIVER ESTUARY SOUTH AFRICA.**
Port Elizabeth Univ. (South Africa). Dept. of Zoology.
For primary bibliographic entry see Field 2L.
W90-01006

**EVALUATION OF HYDROLOGICAL AND BIOLOGICAL INFLUENCES ON CO2 FLUXES FROM A KARST STREAM.**
Virginia Univ., Charlottesville. Dept. of Environmental Sciences.
For primary bibliographic entry see Field 2E.
W90-01025

**WATER CHEMISTRY AND ISOTOPE STUDY OF STREAMS AND SPRINGS IN NORTHERN CHILE.**
Weizmann Inst. of Science, Rehovoth (Israel). Dept. of Isotope Research.
M. Magaritz, R. Aravena, H. Pena, O. Suzuki, and A. Grilli.
Journal of Hydrology JHYDA7, Vol. 108, No. 1-4, p 323-341, Jun 1989. 9 fig, 3 tab, 21 ref.

Descriptors: *Streams, *Springs, *Meteoric water, *Water chemistry, *Geochemistry, *Isotope studies, *Andes Mountains, *Chile, Snow, Altitude, Salinity, Minerals, Sodium, Potassium, Chlorides, Calcium, Silicates, Sulfides, Sulfates, Floods.

The relationship between the stable isotopic and chemical composition of rain, spring, and stream water was studied in the high Andes of northern Chile. The isotopic pattern of the springs is mainly a reflection of the altitude of their recharge areas: however, processes that occur during snow melting seem to play a major role in the high-altitude springs. The streams show patterns similar to the springs in the higher part of the basins, but their isotopic composition is modified along the river course, due mainly to evaporation. The difference in chemical composition between the springs at high and intermediate elevations reflects the duration of water-rock interaction. The best parameter to trace this length of travelling time is the Na/K ratio, which increases as a result of removal of K into alteration minerals (K-silicates). The Na/Cl ratio increases with salinity in springs and decreases in stream water. This reflects the different sources of salt, whereas the main source of salts in spring water is the dissolution of silicate and sulfide minerals. Halite accumulations close to the surface is the main salt source in the streams. During floods the stream water chemical characteristics change, Na/Cl increases with decreased salinity and Na/K decreases. (Author's abstract)
W90-01034

**VARIATIONS IN CONCENTRATIONS OF AQUEOUS ALUMINIUM AND OTHER CHEMICAL SPECIES DURING HYDROLOGICAL EPISODES AT BIRKENES, SOUTHERNMOST NORWAY.**
Senter for Industriforskning, Oslo (Norway).
H. M. Seip, D. O. Andersen, N. Christophersen, T. J. Sullivan, and R. D. Vogt.
Journal of Hydrology JHYDA7, Vol. 108, No. 1-4, p 387-405, Jun 1989. 8 fig, 1 tab, 32 ref.

Descriptors: *Acid rain, *Acid rain effects, *Path of pollutants, *Geochemistry, *Soil water, *Water chemistry, *Aluminum, Catchment areas, Stream waters, Minerals, Hydrogen ion, Fluorides, Chlorides, Sulfates, Silica, Organic carbon, Snowmelt, Gibbsite, Kaolinite, Halloysite, Jurbanite, Birkenes, Norway.

Concentrations of H(+), Al species, total fluoride, silica, TOC, and major cations and anions were measured in stream water and soil water in the Birkenes catchment during base-flow and high discharge hydrological episodes from 1984-86. Snow and meltwater were also sampled before and during the spring snowmelt seasons. During all the rainfall and snowmelt hydrological events for the 5 field periods analyzed, the H(+) concentration increased with flow, whereas inorganic monomeric Al (including Al(3+) increased with flow only during episodes preceded by relatively low flow periods; during subsequent events inorganic monomeric Al remained nearly constant or even decreased. Concentrations of inorganic monomeric Al and H(+) in soil water sampled under saturated conditions were generally stable over time compared to the variations for these species in streamwater. The considerable fluctuations observed for chloride and sulfate concentrations illustrated that displacement of soil water occurred. The results confirm the importance of hydrological factors in determining episodic Al response. Large variations in the saturation indices show that equilibrium with either Al(OH)3 (gibbsite) or Al2Si2O5(OH)4 (kaolinite, halloysite) cannot control Al concentrations in streamwater at Birkenes; the same is true for Al(OH)SO4 (jurbanite) although the saturation index for this mineral is less variable. Most probably, different controlling mechanisms predominate in the different soil layers, producing different chemical signatures which are picked up in the stream to varying degrees depending on hydrological conditions. (Author's abstract)
W90-01037

**DYNAMICS AND CONTENT OF PHOSPHORUS IN THE SEDIMENT OF SEAGRASS MEADOWS (CONTENIDO Y DINAMICA DEL FOSFORO EN EL SEDIMENTO DE PRADERAS DE FANEROGAMAS MARINAS).**
Barcelona Univ. (Spain). Dept. de Ecologia.
For primary bibliographic entry see Field 2L.
W90-01055

**GEOCHEMICAL FEATURES OF THE TER RIVER WATERSHED (NE SPAIN).**
Barcelona Univ. (Spain). Dept. de Ecologia.
F. Sabater.
Oecologia Aquatica, Vol. 9, p 77-87, December 1989. 6 fig, 2 tab, 13 ref.

Descriptors: *Water chemistry, *Geochemistry, *Ter River, *Statistical analysis, Spatial distribution, Chlorides, Sodium, Sulfates, Potassium, Low flow, Reservoirs, Water pollution effects, Spain, Chemical properties.

The different major ion proportions which define the chemical water type in each sampling-station of the Ter River watershed in Spain were assessed. The results show that application of multivariate statistical techniques may help in clustering the different watershed with similar chemical properties characterized by several abiotic factors. The spatial distribution of major dissolved ions was also considered in addition to an approach to determining regional differences in solute levels of the river Ter during low flow conditions. The conductivity increases from < 100 microS/cm to >1,000 microS/cm downstream because of salt accumulation from soil washing and also because of human activity leading to an increase of chloride, sodium, and potassium. Statistical analysis based on the hydrochemical data identified ten groups of sampling stations. There was a general trend in all sampled stations toward a drop in conductivity levels during discharge flow events. At several sampling sites parameters such as chloride, sodium, sulfate, and potassium showed a negative correlation with the volume flow. However, the behavior pattern of these major ions is different at the sampling stations below reservoirs and in polluted sites. In the polluted sites, there are strong fluctuations of the parameters during low flow periods. (Peters-PTT)
W90-01057

**NATURE OF IRON AND MANGANESE SPECIES IN DAM WATERS.**
Birmingham Univ. (England). School of Earth Sciences.
B. Chiswell, and M. Zaw.
Hydrological Processes HYPRE3, Vol. 3, No. 3, p 277-288, Jul-Sep 1989. 2 fig, 6 tab, 34 ref.

Descriptors: *Water chemistry, *Chromatography, *Manganese, *Iron, *Atomic absorption spectroscopy, Water analysis, Spectroscopy, Speciation, Ion exchange, Fulvic acid, Humic acids, Reservoirs.

The molecular weight (M.W.) distributions of iron and manganese species in dam water samples were investigated by use of gel filtration, while the ion-exchangeable and non-ion-exchangeable fractions of these metals were also analyzed by ion-exchange chromatography. For the samples studied, more than 96% of the manganese species present were found to be ion-exchangeable, while less than 35% of iron species were ion-exchangeable. These results correlated with the finding that all the manganese species had molecular weights less than 700, but that the molecular weights of the iron species were mostly in excess of 5000. Electron paramagnetic resonance (EPR) spectroscopy has been used to support the findings that manganese is almost totally present in the form of simple aquated Mn(II)ions. (Author's abstract)
W90-01077

**HYDROCHEMICAL REGIME AND WATER QUALITY IN RESERVOIRS IN CENTRAL ASIA (GIDROKHIMICHESKII REZHIM I KACHESTVO VODY VODOKHRANILISHCH SREDNEI AZII).**
Sredneaziatskii Nauchno-Issledovatel'skii Inst. Irrigatsii, Tashkent (USSR).
For primary bibliographic entry see Field 2H.
W90-01145

**OCCURRENCE OF RADON IN WELL SUPPLIES.**
American Water Works Service Co., Voorhees, NJ. System Water Quality Dept.
For primary bibliographic entry see Field 5F.
W90-01159

**OCCURRENCE OF RADON, RADIUM, AND URANIUM IN GROUNDWATER.**
Environmental Protection Agency, Cincinnati, OH.
J. P. Longtin.
Journal of the American Water Works Association JAWWA5, Vol. 80, No. 7, p 84-93, July 1989. 8 fig, 12 tab, 7 ref.

Descriptors: *Radium radioisotopes, *Uranium, *Radon, *Surveys, *Groundwater pollution, *Drinking water, National Inorganics and Radionuclides Survey.

The need to establish new and revised drinking water regulations lead the US Environmental Protection Agency to conduct the National Inorganics and Radionuclides Survey to obtain information on the occurrence of various contaminants in drinking water from groundwater sources in the United States. The results that relate to radionuclides are discussed and compared with data from other studies showing that general agreement exists among the results from various studies. A description of the acquisition, analysis, and processing of the data is included. (Author's abstract)
W90-01162

**GEOHYDROLOGY OF THE LAURA FRESHWATER LENS, MAJURO ATOLL: A HYDROGEOCHEMICAL APPROACH.**
Geological Survey, Honolulu, HI.
For primary bibliographic entry see Field 2F.
W90-01172

**DIEL FLUCTUATIONS IN BACTERIAL ACTIVITY ON STREAMBED SUBSTRATA DURING VERNAL ALGAL BLOOMS: EFFECTS OF TEMPERATURE, WATER CHEMISTRY, AND HABITAT.**
Academy of Natural Sciences of Philadelphia, Avondale, PA. Stroud Water Research Center.
L. A. Kaplan, and T. L. Bott.
Limnology and Oceanography LIOCAH, Vol. 34, No. 4, p 718-733, June 1989. 3 fig, 3 tab, 70 ref. NSF Grants Nos. DEB 79-21963 and BSR 82-17482.

Descriptors: *Diurnal variation, *Diurnal distribution, *Eutrophication, *Streambeds, *Bacteria, *Water temperature, *Water chemistry, White Clay Creek, Dissolved organic carbon.

Diel fluctuations in stream water temperature and chemistry, microbial biomass, and bacterial activity were measured in White Clay Creek, Pennsylvania, during vernal algal blooms in three different years. Dissolved organic carbon concentrations increased 24-37% over early morning minima and temperature increased nearly 10 C over a 7-10 hour period. Total carbohydrates and monosaccharides exhibited irregular fluctuations with total carbohydrates showing concentration peaks in the morning and afternoon. Acetate concentrations were highest in midafternoon, while the concentration pattern for primary amines differed from the dissolved organic carbon pattern with highest values at midnight. No distinct diel patterns were found for streambed ATP, GTP: ATP, chlorophyll a, and total or active bacteria, although significant year to year and between habitat differences were observed. Bacterial activity, measured by phospholipid biosynthesis, total lipid biosynthesis, respiration, and incorporation of 3H thymidine into DNA increased 1.4 fold to 3.0 fold from morning to afternoon. Microcosm experiments indicated that the activity of bacteria attached to sediments was more sensitive to increases in water temperature than to changes in water chemistry, whereas bacteria attached to porcelain disks responded to the influences of both temperature and water chemistry. (Author's Abstract)
W90-01187

**SALT CONCENTRATIONS AND CHEMICAL TYPES OF LAKE, RIVER, SNOW, AND HOT SPRING WATERS FROM THE TIBETAN PLATEAU.**
Shiga Univ., Otsu (Japan). Faculty of Liberal Arts and Education.
For primary bibliographic entry see Field 2H.
W90-01294

**HYDROCHEMICAL CHARACTERIZATION OF ALPINE AND ALPINE-SUBALPINE STREAM WATERS, COLORADO ROCKY MOUNTAINS, U.S.A.**
Colorado State Univ., Fort Collins. Dept. of Earth Resources.
J. D. Stednick.
Arctic and Alpine Research ATLPAV, Vol. 21, No. 3, p 276-282, August 1989. 2 fig, 4 tab, 19 ref.

Descriptors: *Water chemistry, *Alpine regions, Water yield, Oligotrophy, Sodium compounds, Dissolved solids, Calcium compounds, Magnesium, Potassium, Hydrogen, Bicarbonates, Sulfates, Nitrates, Chlorides, Orthophosphates, Solutes, Streamflow, Snowmelt, Precipitation, Biochemistry, Denudation, Silica, Colorado.

The hydrochemistry of stream waters in an alpine basin and alpine-subalpine basin in northern Colorado were characterized after intensive chemical sampling from May 1986 to May 1987. The alpine basin had an annual water yield of 115 centimeters and was characterized as an ultra-oligotrophic sodium-bicarbonate type water. The alpine stream averaged 130 microequivalents per liter (microeq/L) total dissolved solids. The alpine-subalpine basin had an annual water yield of 72 centimeters and was typed as an oligotrophic calcium-bicarbonate water. The alpine-subalpine stream averaged approximately 300 microeq/L total dissolved solids. Concentrations for sodium, calcium, magnesium, potassium, hydrogen, bicarbonate, sulfate, nitrate, chloride, and orthophosphate were measured for both sites. Solute concentrations were generally negatively correlated with streamflow. No chemical pulse was observed at either site when snowmelt was initiated. Alpine waters had higher nitrate-nitrogen concentrations than the alpine-subalpine waters, which may have resulted from higher nitrate-nitrogen concentrations in precipitation than in stream waters and snowmelt. Alpine streamflow routing provided insufficient opportunity for biological removal mechanisms to completely utilize the incident nitrate-nitrogen. Denudation rates as measured by silica export were approximately equal for both waters at 0.0068 millimeters per year. (Author's abstract)
W90-01339

**TEMPERATURE DATA AVAILABLE ON THE DEPARTMENT OF WATER AFFAIRS' CHEMICAL DATA BASE.**
Hydrological Research Inst., Pretoria (South Africa).
For primary bibliographic entry see Field 7B.
W90-01407

**EFFECTS OF HYDROCHEMISTRY VARIABILITY ON WATER QUALITY SAMPLING FREQUENCIES IN AN ALPINE-SUBALPINE FOREST BASIN.**
Colorado State Univ., Fort Collins. Dept. of Earth Resources.
J. D. Stednick.
IN: Forest Hydrology and Watershed Management. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication No. 167, 1987. p 401-407, 5 tab, 4 ref.

Descriptors: *Water chemistry, *Forest hydrology, *Sampling, *Water sampling, *Chemical analysis, Statistical analysis, Nutrients, Precipitation, Streamflow, Data acquisition.

Samples of precipitation, soil water, and streamflow from Hourglass Creek in the Colorado Rocky Mountains were analyzed for pH, conductivity, alkalinity, N, P, Ca, Mg, Na, and K. Time-weighted and volume weighted annual means were not significantly different from arithmetic mean concentrations. A minimum sample size was calculated. For precipitation, with an allowed error of +/- 10% of the annual mean at 9% confidence, minimum sample sizes ranged from 1 sample for pH, orthophosphate, Mg and K to >120 samples for conductivity, sulfate, and Na. Streamflow had minimum sample size estimates of 1 sample for orthophosphate and Mg to 45 samples for Ca and 102 samples for conductivity. (See also W90-01432) (Author's abstract)
W90-01469

**IMPLICATIONS OF MIXTURE CHARACTERISTICS ON HUMIC-SUBSTANCE CHEMISTRY.**
Geological Survey, Denver, CO.
J. A. Leenheer, P. A. Brown, and T. I. Noyes.
IN: Aquatic Humic Substances: Influence on Fate and Treatment of Pollutants. American Chemical Society, Washington, DC. 1989. p 25-39, 3 fig, 4 tab, 21 ref.

Descriptors: *Water chemistry, *Humic acids, *Fulvic acids, *Chemical reactions, Fractionation, Sediments, Suwannee River.

The chemistry of complex mixtures usually cannot be described as the sum of the characteristics of the individual components because of intermolecular interactions that modify component characteristics. A study of both inter-and intramolecular interactions in the Suwannee River fulvic acid, by measurement of the dependence of density on concentration in various solvents, indicated that polar functional groups (carboxyl, phenolic, hydroxyl, and ketone) were responsible for most of the molecular interactions in water. A two-stage fractionation of Suwannee River fulvic acid on silica gel resulted in 31 fractions that had variable molecular weight distributions and acid-group contents. Intramolecular interactions were determined to predominate over intermolecular interactions for the Suwannee River fulvic acid in all solvents at weight-volume concentrations less than 1%. (See also W90-01491) (Author's abstract)
W90-01493

**CHARACTERIZATION OF A STREAM SEDIMENT HUMIN.**
Colorado School of Mines, Golden. Dept. of Chemistry and Geochemistry.
J. A. Rice, and P. MacCarthy.
IN:IN: Aquatic Humic Substances: Influence on Fate and Treatment of Pollutants. American Chemical Society, Washington, DC. 1989. p 41-54, 4 fig, 2 tab, 32 ref.

Descriptors: *Humic acids, *Sediments, *Fulvic acids, *Fate of pollutants, Organic compounds, Bottom sediments, Chromatography, Gas chromatography, Spectroscopy, Lipids.

The isolation of a stream sediment humin by a methyl isobutyl ketone (MIBK) liquid-liquid partitioning procedure is described. An extension of the MIBK method is used to fractionate the humin into a bound humic acid fraction, a lipid fraction, and an inorganic fine-grained residue. The humin, bound humic acid, humic acid, and fulvic acid, all isolated by the MIBK method, were characterized by IR spectroscopy, acidic functional group analysis. and elemental analysis. The lipids were characterized by gas chromatography--mass spectrometry (GC-MS). The humin is similar to the humic acid, although the bound humic acid characteristics are intermediate between those of humic acid and fulvic acid. The lipid associated with the humin was separated into extractable (bitumen) and nonextractable (bound lipid) fractions. Each lipid fraction exhibited distinct n-alkane and n-fatty acid profiles by GC-MS. These observations are discussed with respect to the nature of humin and the fate of hydrophobic organic chemicals in the environment. (See also W90-01491) (Author's abstract)
W90-01494

**NATURE OF COMMERCIAL HUMIC ACIDS.**
Colorado School of Mines, Golden. Dept. of Chemistry and Geochemistry.
P. MacCarthy, and R. L. Malcolm.
IN: Aquatic Humic Substances: Influence on Fate and Treatment of Pollutants. American Chemical Society, Washington, DC. 1989. p 55-63, 2 fig, 1 tab, 9 ref.

Descriptors: *Humic acids, *Spectroscopy, *Chemical properties, *Laboratory methods.

In a follow-up to a study based primarily on solid-state 13C-NMR spectroscopy, commercial humic acids were investigated by infrared spectroscopy. Pronounced similarities were observed between the infrared spectra of all the commercial materials, and these 'humic acids' appear to be partly in the salt form or complexed with metals. The commercial materials differ somewhat from each other in terms of their mineral compositions. The infrared spectra of the commercial materials are not remarkably different from humic acids isolated from peat, soils, and leonardite, but pronounced differences between these two classes of materials are revealed by 13 C-NMR spectroscopy. The use of commercial humic acids as analogues of soil and water humic substances is criticized in this chapter. The adverse impact of high ash content on elemental analyses is illustrated, and the desirability of using direct methods for elemental determinations is discussed. (See also W90-01491) (Author's abstract)
W90-01495

**WATER-SOLUBILITY ENHANCEMENT OF NONIONIC ORGANIC CONTAMINANTS.**
U.S. Geological Survey, Denver Federal Center, Denver, CO 80225.
For primary bibliographic entry see Field 5B.
W90-01501

**SORPTION OF CHLORINATED HYDROCARBONS IN THE WATER COLUMN BY DISSOLVED AND PARTICULATE ORGANIC MATERIAL.**
Drexel Univ., Philadelphia, PA. Environmental Studies Inst.
For primary bibliographic entry see Field 5B.
W90-01502

**CHARGE-TRANSFER INTERACTION BETWEEN DISSOLVED HUMIC MATERIALS AND CHLORANIL.**
State Univ. of New York at Syracuse. Coll. of Environmental Science and Forestry.
For primary bibliographic entry see Field 5B.
W90-01503

**METHODS FOR DISSOLVING HYDROPHOBIC COMPOUNDS IN WATER: INTERACTIONS WITH DISSOLVED ORGANIC MATTER.**
Manitoba Univ., Winnipeg. Dept. of Soil Science.
For primary bibliographic entry see Field 5B.
W90-01508

**SUNLIGHT-INDUCED PHOTOCHEMISTRY OF HUMIC SUBSTANCES IN NATURAL WATERS: MAJOR REACTIVE SPECIES.**
Florida International Univ., Miami. Drinking Water Research Center.
For primary bibliographic entry see Field 5B.
W90-01513

**AQUATIC HUMIC SUBSTANCES AS SOURCES AND SINKS OF PHOTOCHEMICALLY PRODUCED TRANSIENT REACTANTS.**
Eidgenoessische Anstalt fuer Wasserversorgung, Abwasserreinigung und Gewaesserschultz, Duebendorf (Switzerland).
For primary bibliographic entry see Field 5B.
W90-01514

**WILL CLOUDS PROVIDE A NEGATIVE FEEDBACK IN A CO2-WARMED WORLD.**
Liverpool Univ. (England). Dept. of Geography.
For primary bibliographic entry see Field 2B.
W90-01589

**PB-210 IN GROUND-LEVEL AIR AND SNOW IN THE ENVIRONMENT OF THE KARLSRUHE NUCLEAR RESEARCH CENTER (KERNFORSCHU?NGSZENTRUM KARLSRUHE G.M.B.H).**
Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Hauptabteilung Sicherheit.
N. Parveen, and H. Schuettelkopf.
Available from National Technical Information Service, Springfield, VA 22161 as TIB/B88-81077/GAR, Price codes: E07 in paper copy. Report KFK-4345, January 1988. 16p, 2 fig, 6 tab, 16 ref. English summary.

Descriptors: *Lead radioisotopes, *Air-earth interfaces, *West Germany, *Snow, Lead aerosols, Deposition, Rhine Valley, Resuspension.

Pb-210 concentrations in air and snow were measured near the Karlsruhe Nuclear Research Center (KfK). The results revealed that the Pb-210 concentrations in air near the KfK are lower by a factor of 1.5 to 2.0 compared to those in other parts of Germany. According to these results the

Pb-210 concentration in snow is lower than the expected values for the middle latitudes of the northern hemisphere. These low values may be a consequence of the low content of natural radioactivity in the soil of the Rhine river valley. The deposition rate of Pb-210 aerosols on snow is extremely low. The low deposition can be explained by a combined effect of lower deposition velocity and an increased resuspension for Pb-210 aerosols on ice-covered snow layer. (Author's Abstract)
W90-01736

**ION BALANCE IN FOREST ECOSYSTEMS (IONBALANCE I SKOV-KOSYSTEMER).**
Miljoestyrelsen, Roskilde (Denmark). Luftforureningslaboratoriet.
J. Bille-Hansen, and M. F. Hovmand.
Available from National Technical Information Service, Springfield, VA 22161 as DE88750388/GAR , Price codes: A05 in paper copy, A01 in microfiche. Report MST-LUFT-A-112. February 1987. 100p, 20 fig, 21 tab, 32 ref. In Danish.

Descriptors: *Water chemistry, *Acid rain, *Forest soils, *Denmark, *Forest hydrology, *Soil chemistry, Sulfur, Nitrogen, Hydrogen ion concentration, Rainfall, Throughfall, Stemflow, Litterfall, Ozone.

Twenty-four year old beech and Norway spruce stands were divided into two blocks for a species trial, a western block on old-pleistocene sandy deposits, and an eastern block on young-morainic loamy deposits. Essential parameters are wet and dry deposition of S-compounds, and N-compounds and Cl(-) as well as H(+) and other cations. Rainfall, throughfall, stemflow, and litterfall were measured and chemically analyzed. Also ambient atmospheric concentrations of SO2, NO2, O3, and aerosols were determined. Soils were physically and chemically characterized and percolating soil water chemistry determined. The aim of the project was to estimate as precisely as possible the ion-turnover in the systems. (Author's abstract)
W90-01739

**STUDY OF CATIONS IN THE PRECIPITATION OF ESTACAO ANTARTICA COMANDANTE FERRAZ (ESTUDO DE CATIONS NA PRECIPITACAO ANTARTICA ESTACAO COMANDANTE FERREZ).**
Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
M. C. Forti, A. W. Serter, and L. M. Moreiranordemann.
Available from National Technical Information Service, Springfield, VA 22161 as N88-19843/7/GAR, Price codes: A03 in paper copy, A01 in microfiche. Report INPE-4377-PRE/1197, September 1987. 19p, 3 fig, 6 tab, 12 ref. English summary.

Descriptors: *Chemistry of precipitation, *Snow, *Antarctica, Sodium, Potassium, Magnesium, Calcium, Seasonal variation.

Rain water and fresh snow samples were collected at Estacao Antarctica Comandante Ferraz, during one year (Jan. 86 to Mar. 87). These samples were analyzed for Na+, K+, Mg(2)+ and Ca(2)+ and the behavior of these cations in liquid and solid precipitations is presented. The marine influence on rain water reported previously is confirmed in these analyses; samples of fresh snow also show this influence. Seasonal variation was not detected except in the case of Na+ for snow samples. It was found that the average cationic concentrations of fresh snow were 70 percent smaller than those of rain water. (Author's Abstract)
W90-01780

**PARTICLE SIZE AND CONCENTRATION OF IRON(III) IN RIVER WATERS (UBER DIE PARTIKELGROSSE UND KONZENTRATION DES EISENS (III) IN FLUSSWASSERN).**
Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Radiochemie.
W. Palmer.
Available from National Technical Information Service, Springfield, VA 22161 as TIBB-8880940, Price codes: E11 in paper copy. Report KfK 4289. August 1987. 95p, 20 fig, 8 tab, 55 ref, 1 append. English summary.

Descriptors: *Water chemistry, *Iron, *West Germany, *Solubility, Filtration, Diafiltration, Donau River, Mosel River, Neckar River, Ruhr River, Elbe River.

The particle size of iron in river Rhine water was investigated by diafiltration. Total iron was 300-400 microg/L. About 10% passed a 0.45 microm filter. The main part of the iron in this filtrate (60%) has a particle size of < 0.45 microm > 100,000 Dalton. Twenty percent are colloids of molar mass 100,000-10,000 Dalton, 12% are in the fraction 10,000-1,000 Dalton and only 4-5% are 'dissolved species' of molar mass <1,000 Dalton. This shows that the identification of the 0.45 microm filtrate as 'dissolved iron' is erroneous. In order to explain the concentration of the fraction passing the 100-Dalton-filter the solubility of Lepidocrocite and amorphous iron hydroxide was investigated. Equilibrium constants as 25 C were obtained. Using these constants the chemical speciation was calculated. It is shown that the concentration of the iron in the 1000-Dalton-filtrate of Rhine River water is equal to the equilibrium solubility of amorphous iron(III) hydroxide. Diafiltration experiments with samples from the Donau, Mosel, Neckar, Ruhr, and Elbe Rivers show that this applies to river waters in general if their compositions are not significantly different from those of the investigated ones. (Peters-PTT)
W90-01789

**COMPARISON BETWEEN THE GROUNDWATER QUALITY IN AN INTERMOUNTAINOUS AND A COASTAL PLAIN IN YEMEN ARAB REPUBLIC.**
San'a Univ. (Yemen). Dept. of Geology.
H. A. El-Nakhal.
IN: Irrigation and Water Allocation. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication no. 169, 1987. p 73-80. 4 fig, 4 tab, 4 ref.

Descriptors: *Groundwater quality, *Yemen Arab Republic, *Coastal plains, *Water chemistry, *Geochemistry, *Water quality, *Mountains, Irrigation water, Domestic use, Saline water intrusion, Comparison studies.

Groundwater qualities of the Sana'a and Hudaydah areas, which represent an intermountainous and a coastal plain, respectively, are compared. The quality of the groundwater of both areas was evaluated for irrigation and domestic use by applying the Wilcox (1955) and the Doneen (1961) methods as well as the standards accepted by the World Health Organization (WHO) (1971). The results of the evaluation based on total dissolved solids, electrical conductivity, pH, anions, and cations show that the quality of Sana'a water is much better than that of Hudaydah. All samples collected from the Sana'a area are suitable for domestic use, whereas all of the Hudaydah samples proved unsuitable according to WHO standards. The poor quality of Hudaydah groundwater is attributed to its contamination with seawater and to the low rate of the Hudaydah annual rainfall. (See also W90-01828) (Geiger-PTT)
W90-01835

**NUMERICAL ANALYSIS OF THE EFFECT OF PERIODICITY ON SOLUTE MOVEMENT DURING INTERMITTENT LEACHING.**
New South Wales Univ., Kensington (Australia). School of Civil Engineering.
For primary bibliographic entry see Field 2G.
W90-01836

**EFFECTS OF IRRIGATION ON THE CHEMICAL BALANCE IN THE ECOLOGICAL ENVIRONMENT OF WATER AND SOIL.**
Changchun Coll. of Geology (China). Station of Environmental Hydrogeology.
For primary bibliographic entry see Field 3F.
W90-01839

## 2L. Estuaries

**NUTRIENT STATUS OF THE SUNDAYS RIVER ESTUARY SOUTH AFRICA.**
Port Elizabeth Univ. (South Africa). Dept. of Zoology.
W. D. Emmerson.
Water Research WATRAG, Vol. 23, No. 8, p 1059-, August 1989. 5 fig, 3 tab, 34 ref.

Descriptors: *South Africa, *Estuaries, *Water pollution sources, *Nutrients, *Salinity, Escherichia coli, Nitrogen, Phosphorus, Silica, Municipal wastes, Industrial wastes, Sundays estuary, Swartkops estuary, Kromme estuary.

The nutrient status of the Sundays, an important estuarine system in the eastern Cape, South Africa, is described together with other physio-chemical parameter and compared with two other local systems, namely the Swartkops and the Kromme. In the Sundays, significant nutrients gradients between the head and mouth of the estuary were found for nitrite, nitrate, phosphate, total phosphorus, silicate and fecal E. coli. Significant correlations were also found between riverflow/rainfall and some headwater nutrients. Highly significant correlations were similarly found between total inorganic nitrogen, total phosphorus and silica and salinity. In each case the relationship was linear indicating a conservative nutrient distribution along the estuary. N:P ratios calculated separately for the head and mouth regions were 4.52:1 and 2.51:1, respectively, suggesting strong nitrogen enrichment in the headwaters from citrus fertilizer seepage upstream. Although phosphate values in the Sundays were double that of the Kromme (0.233 and 0.121 mg/L respectively), they were low compared to the Swartkops (1.320 mg/L) which has phosphate enrichment due to urban sewage and industrial effluent. Fecal, E. coli was concomitantly higher in the Swartkops (640/100 ml) compared to the pollution free Sundays and Kromme (18 and 26/100 ml, respectively). Both the Swartkops and the Kromme displayed sink distribution for N and P. Both these estuaries are also rich in macrophytes with open Spartina marshes and intertidal Zostera beds. By contrast, the channel-like Sundays estuary is conservative for N, P and Si and has no saltmarshes. It is suggested therefore that the Sundays contributes nutrients to the adjacent, extremely productive Sundays beach surf zone system, which, despite nutrient recycling still requires large amounts of extrinsic nutrients in order to maintain high productivity. (Author's abstract)
W90-01006

**SEASONAL VARIATIONS IN CONCENTRATIONS AND FLUXES OF DISSOLVED ORGANIC AND INORGANIC MATERIALS IN A TROPICAL, TIDALLY-DOMINATED, MANGROVE WATERWAY.**
Australian Inst. of Marine Sciences, Townsville.
K. G. Boto, and J. T. Wellington.
Marine Ecology Progress Series MESEDT, Vol. 50, No. 1-2, p 151-160, Dec 15 1988. 3 fig, 3 tab, 32 ref.

Descriptors: *Tidewater, *Nutrients, *Wetlands, *Mangrove swamps, *Salt marshes, *Coastal waters, *Dissolved organic carbon, *Dissolved solids, *Nitrogen, *Phosphorus, *Tropical regions, Ammonium, Nitrates, Nitrites, Phosphates, Phytoplankton, Photosynthesis, Tides, Seasonal variation, Australia.

Variations in concentrations, and extent of outwelling, or import, of dissolved inorganic and organic materials were examined in a tropical mangrove system at Hinchinbrook Creek, northern Australia. In this system about 35% of the forest net primary production is exported to nearby coastal waters through tidal export of particulate organic matter, primarily mangrove plant litter. Concentrations of dissolved organic C (DOC), N, and P, along with inorganic N and P species (ammonium, nitrate, nitrite and soluble reactive phosphate) were consistently much lower than those reported for many temperate salt marshes or estuarine mangrove

waters. Significant variations in mean concentrations of all dissolved materials with time of year were found, although no consistent seasonal periodicity was apparent. Nitrate + nitrite was the only component which showed a strong relationship with simple variables, notably solar radiation and water temperature. The dissolved organic materials did not appear to be linked with the photosynthetic activity of phytoplankton, benthic algae or the mangroves, in contrast to the inorganic nutrients which showed small but statistically significant differences between daytime and nighttime concentrations. A consistently high atomic C:N or C:P ratio for the dissolved organics suggests that this material is mostly refractory and in an advanced diagenetic stage. Significant net fluxes over individual tidal cycles were obtained for DOC, nitrate + nitrite, and soluble reactive phosphate. The other entities, particularly ammonium, showed very large and random fluctuations throughout a tidal cycle, thus preventing accurate estimates of their fluxes. In all cases there was no apparent seasonal variation in the direction or magnitude of net fluxes. Integrating over a year, all components showed very small and negligible net transport to or from the system, except for total dissolved P which showed a net annual import of 24% of net forest primary production requirements. (Author's abstract)
W90-01040

**FLUX OF AMMONIUM FROM SURF-ZONE AND NEARSHORE SEDIMENTS IN NAHANT BAY, MASSACHUSETTS, USA IN RELATION TO FREE-LIVING PILAYELLA LITTORALIS.**
Massachusetts Univ., Amherst. Dept. of Botany.
A. M. Pregnall, and S. L. Miller.
Marine Ecology Progress Series MESEDT, Vol. 50, No. 1-2, p 161-167, Dec 15 1988. 4 fig, 1 tab, 35 ref.

Descriptors: *Algae, *Beaches, *Nearshore processes, *Nitrogen, *Ammonium, Pilayella, Decomposition, Nahant Bay, Massachusetts.

The availability of inorganic N in the surf-zone of Nahant Bay, Massachusetts was studied in relation to the distribution and decomposition of a free-living population of the filamentous brown alga Pilayella littoralis. Slight ammonium enrichment was evident in the surf zone of one beach location and in the immediate vicinity of a sewage treatment plant outfall. Profiles of sediment ammonium were determined over an annual cycle at 4 mid-intertidal beach sites. Most sites contained sediment ammonium from 0.05-0.1 micromol/cu cm, while one site with chronic algal deposition and burial showed greatly elevated sediment ammonium levels (< or = 6 micromol/cu cm). Efflux of ammonium from deep and shallow subtidal sediments and from intertidal surf-zone sediments was typically < or = 100 micromol/sq m/h, except at the site with chronic algal burial and decomposition, where flux of ammonium ranged from 200-2000 micromol/sq m/h. Sediment concentrations and benthic flux of ammonium from sandy subtidal and surf-zone sediments are generally low in Nahant Bay; however, beaches with chronic deposition and burial of free-living P. littoralis have very high ammonium content and flux owing to the decomposition of algae that have effectively concentrated N from a much larger area of the bay. (Author's abstract)
W90-01041

**ENVIRONMENTAL FORCING VERSUS ENDOGENOUS CONTROL OF PHOTOSYNTHESIS IN INTERTIDAL EPILITHIC MICROALGAE.**
Laval Univ., Quebec. Dept. de Biologie.
I. Lamontagne, A. Cardinal, and L. Fortier.
Marine Ecology Progress Series MESEDT, Vol. 51, No. 1-2, p 177-187, Jan 16 1989. 9 fig, 1 tab, 34 ref.

Descriptors: *Physiological ecology, *Algae, *Photosynthesis, *Intertidal areas, Photoadaptation, Photoinactivation, Spring tides, Neap tides, Light intensity, Circadian cycle.

Photoadaptation and photosynthetic capacity of an intertidal epilithic microflora were measured hourly over a period of 8 d. The algae were photoadapted to the dim light intensities experienced when submerged and showed little resistance to the extreme irradiances received when exposed. During neap tide when the community was permanently submerged, the photosynthetic response of algae collected hourly in the field followed a circadian cycle. The endogenous control of this cycle was demonstrated by isolation experiments. During spring tide, photosynthetic processes were photoinactivated at low tide when extreme irradiances reached the algae. These results lead to the general hypothesis that short-term variability in the photosynthetic capacity of intertidal epilithic microalgae is controlled primarily by endogenous phasing at neap tide and tidal forcing at spring tide. Time series of in situ production were reconstructed from solar irradiance measurements and hourly estimates of the parameters of the Photosynthesis-Irradiance curve. Despite the additional stress of low tide exposure, average daily production was comparable between spring and neap tides. (Author's abstract)
W90-01042

**DISSOLVED ORGANIC CARBON-BACTERIA INTERACTIONS AT SEDIMENT-WATER INTERFACE IN A TROPICAL MANGROVE SYSTEM.**
Australian Inst. of Marine Sciences, Townsville.
K. G. Boto, D. M. Alongi, and A. L. J. Nott.
Marine Ecology Progress Series MESEDT, Vol. 51, No. 3, p 243-251, Feb 6 1989. 2 fig, 5 tab, 26 ref.

Descriptors: *Mangrove swamps, *Sediment-water interfaces, *Tropical regions, *Dissolved organic carbon, *Bacteria, *Tidewater, Interstitial water, Seasonal variation, Mercury poisoning, Australia.

In order to determine the efficiency of in situ carbon recycling in tropical mangrove sediments, and the contribution of porewater dissolved organic carbon (DOC) to surface-sediment bacterial production, concentrations and fluxes of DOC were measured and compared with simultaneous estimates of bacterial densities, productivity and specific growth rates, in a mangrove forest in Queensland, Australia. The range of interstitial DOC concentrations (4-50 microgram C/l) was similar to that reported for temperate marine sediments although seasonal variations were much less apparent. Soluble tannins constituted 2-51% of the interstitial DOC pools, which varied significantly with tidal elevation (high > mid > low intertidal) and showed significant variation with sediment depth (to 1 m) only in the mid intertidal. Bacterial densities and activity in surface sediments (to 1 cm) were high (annual range in productivity: 0.9-4.1 g C/sq m/d), consistent with previous estimates at this site. Surface (1 cm depth) sediment DOC concentrations varied with elevation in the intertidal zone (10 sites from low to high intertidal), and showed no correspondence with seasonal or spatial variations in bacterial parameters, except for a significant correlation between DOC and bacterial growth rate, in austral autumn, for samples throughout the tidal range. Despite the high concentration gradient of DOC between porewaters and overlying tidal waters, significant efflux of DOC was rarely detected unless sediments were poisoned, to 1 cm depth, with mercury, which resulted in significant and generally high rates of efflux. Efflux rates varied widely with tidal elevation and season (range: 0-2.4 g C/sq m/d). These DOC flux rates provide, on average, 35% (range: 0-100%) of bacterial productivity requirements at the sediment-water interface. This study suggests that the mangrove sediments function as an efficient sink for DOC and that its export from the system is minor. (Author's abstract)
W90-01043

**POTENTIAL FOR EVOLUTION OF TOLERANCE TO SODIUM CHLORIDE, CALCIUM CHLORIDE, MAGNESIUM CHLORIDE AND SEAWATER IN FOUR GRASS SPECIES.**
Liverpool Univ. (England). Dept. of Botany.
M. Ashraf, T. NcNeilly, and A. D. Bradshaw.
New Phytologist NEPHAV, Vol. 112, No. 2, p 245-254, Jun 1989. 2 fig, 5 tab, 20 ref.

Descriptors: *Salt marshes, *Grasses, *Halophytes, *Salt tolerance, *Evolution, *Genetics, *Plant physiology, *Plant growth, Seawater, Sodium chloride, Calcium chloride, Magnesium chloride, Agrostis, Holcus, Lolium.

To examine the contrasting genetic potentials of different species, which would allow or prevent the evolution of tolerance to naturally saline environments, the growth of selected tolerant and normal lines of Agrostis stolonifera, A. capillaris, Holcus lanatus, and Lolium perenne, in NaCl, CaCl2, MgCl2 and seawater solutions was examined. NaCl tolerant lines of all 4 species had significantly greater root growth in NaCl, CaCl2 solutions, and seawater than unselected lines, but in MgCl2 only the NaCl tolerant lines of H. lanatus had significantly longer roots than the unselected line. Screening of seedlings in solution culture in all 4 species for tolerance to the same salt solutions suggested that variability was available in each species for enhanced tolerance to each salt. When the selected material was tested as adults, the superior tolerance in response to increased seawater concentration remained for all lines in all species except those of A. capillaris and H. lanatus. The results suggest that all 4 species have genetic potential for the evolution of salt tolerance. The failure of some of these species to evolve salt tolerant populations in nature is likely to be due to other factors in naturally saline environments, for which the necessary adaptive genetic potential is lacking. (Author's abstract)
W90-01044

**DYNAMICS AND CONTENT OF PHOSPHORUS IN THE SEDIMENT OF SEAGRASS MEADOWS (CONTENIDO Y DINAMICA DEL FOSFORO EN EL SEDIMENTO DE PRADERAS DE FANEROGAMAS MARINAS).**
Barcelona Univ. (Spain). Dept. de Ecologia.
M. Vidal.
Oecologia Aquatica, Vol. 9, p 41-59, December 1988. 10 fig, 11 tab, 62 ref. English summary.

Descriptors: *Sea grasses, *Wetlands, *Sediments, *Phosphorus, *Mineralogy, *Sediment-water interfaces, Interstitial water, Aquatic plants, Limiting nutrients.

The sediment phosphorus concentrations of different seagrass meadows were determined, with special emphasis on the spatial variation of phosphorus in pore water. Additionally, a preliminary attempt was made to evaluate phosphorus exchange at the sediment water interface and the role of the plants in these processes. Pore water dissolved phosphorus ranged between 1 and 5 microgm at P/L, and total sediment phosphorus concentrations ranged between 150 and 250 microgm P g dry weight/L. In sediment below a Posidonia oceanica (L.) Delile meadow a clear increase of PRS in pore water is shown in a depth gradient, related to a decrease of Posidonia cover. In addition comparing these data with a nearfound bare sediment, two differences arose: total phosphorus content in the bare sediment is higher, but below Posidonia the labile fraction is much more important; both facts appear to reflect the influence of the rizhosphere upon sediment dynamics. The mineralogical composition of the sediment and preliminary results of laboratory experiments suggest that carbonate fluorapatite can play a major role in the equilibrium between particulate and dissolved phosphorus forms in the Posidonia system. That seagrasses exert an important influence upon sediment phosphorus dynamics was also evident in other seagrass meadows (dominated by Cymodocea nodosa (Ucria) Ascherson, Ruppia cirrhosa Petagna Grande, Zostera noltii Homemann), where plant activity had a clear influence upon the vertical distribution of pore water PRS. The labile phosphorus fraction of this sediment was small compared to that in the Posidonia system. This difference may be related to differences in the mineralogical composition of the sediment, with the presence of montmorillonite. Whatever the relative importance of total phosphorus compared to labile phosphorus, the labile phosphorus fraction appears sufficient to meet the phosphorus requirements of

the plants, and phosphorus limitation of plant growth appears unlikely. (Author's abstract)
W90-01055

**SOIL MICROMORPHOLOGY OF A CHESAPEAKE BAY TIDAL MARSH: IMPLICATIONS FOR SULFUR ACCUMULATION.**
Maryland Univ., College Park. Dept. of Agronomy.
M. C. Rabenhorst, and K. C. Haering.
Soil Science SOSCAK, Vol. 147, No. 5, p 339-347, May 1989. 6 fig, 1 tab, 23 ref.

Descriptors: *Tidal marshes, *Chesapeake Bay, *Sediments, *Soil chemistry, *Aquatic soils, *Sulfur, Pyrite, Iron, Sulfur bacteria, Sulfates.

Soils were examined along a transect across a submerged upland tidal marsh on the eastern Shore of the Chesapeake Bay in Maryland. The soil was classified as a Terric Sulfihemist and was underlain by silty mineral sediments. Total S in the soil was partitioned into organic S, pyrite S, and soluble SO4(--) components. In the organic horizons, the ratio of pyrite S to total S was variable, ranging from 10 to 60%. The high levels of SO4(--) and organic matter in the peat, as well as the presence of free S(--), suggest that Fe is limiting pyrite accumulation in these horizons. Pyrite was identified in thin section by its spherical, framboidal habit and was confirmed in thin section and in grain mounts of heavy minerals using an electron microprobe. Individual or small clusters of framboids appeared to be randomly distributed through the organic horizons with few zones or pockets of high concentration. This was consonant with the low input of reactive (easily reducible) Fe (III) adsorbed to mineral sediments added to this isolated marsh. In the underlying mineral substratum, organic matter was thought to be limiting pyrite accumulation by controlling available energy for reduction. In this zone pyrite was concentrated in root channels where there had been some organic substrate for microbial sulfate reduction. The factors controlling pyrite accumulation in these tidal marsh soils may differ dramatically over distances as short as a few centimeters. (Author's abstract)
W90-01062

**SEASONAL CHANGES IN LARVAL POPULATIONS OF CULICOIDES SUBIMMACULATUS LEE & REYE (DIPTERA:CERATOPOGONIDAE), WITH OBSERVATIONS ON THE INFLUENCE OF TIDES ON LARVAL ECOLOGY.**
Queensland Univ., Brisbane (Australia). Dept. of Entomology.
P. B. Edwards.
Australian Journal of Marine and Freshwater Research AJMFA4, Vol. 40, No. 1, p 69-78, 1989. 4 fig, 3 tab, 18 ref.

Descriptors: *Insects, *Aquatic insects, *Coastal marshes, *Intertidal areas, Seasonal variation, Tidal effects, Australia.

At Tingalpa Creek, Brisbane, Australia larvae and pupae of Culicoides subimmaculatus were most numerous 1.94 m above datum, midway between mean high-water neaps and mean high-water springs. Monitoring of a field population of immature stages indicated that C. subimmaculatus completes four generations a year, and overwinters in the 4th larval instar. Adults emerge during synchronized periods associated with the lunar tidal cycle; however laboratory experiments indicated that tidal coverage did not affect the time of adult eclosion or of pupation. It is suggested that synchronization occurs at an earlier point in the life cycle, possibly at ecdysis of 3rd or 4th instars. (Author's abstract)
W90-01070

**VARIATION IN THE COMPONENTS OF BENTHIC COMMUNITY STRUCTURE IN A COASTAL LAGOON AS A FUNCTION OF SPATIAL SCALE.**
Western Australia Univ., Nedlands. Dept. of Zoology.
A. Hatcher.
Australian Journal of Marine and Freshwater Research AJMFA4, Vol. 40, No. 1, p 79-96, 1989. 4 fig, 8 tab, 25 ref.

Descriptors: *Bays, *Benthos, *Lagoons, *Spatial distribution, Nearshore processes, Australia, Benthic environment, Australia.

The perception of community structure is strongly related to the spatial resolution of data collection. To quantify variation in community structure at several spatial scales, the benthos was examined on the limestone substratum in a nearshore coastal lagoon. Community structure was described using a form of pattern analysis called correspondence analysis. Variance at three spatial scales were measured. These scales were described as (1) between offshore and nearshore reefs (kilometers); (2) among areas on the nearshore reef-line (< 1 km); and (3) between community types on the nearshore reef-line (tens of meters and less). Organisms were classified according to higher taxa/functional classes. Parameters which varied between reef-lines included: (1) community composition determined using multivariate ordination, (2) cover by calcareous and filamentous algae and (3) abundance of seagrass and juvenile kelp (Ecklonia radiata). Among the areas on the nearshore reef-line. variance in community composition was due to the distribution of animals. There was a south to north gradient of increasing cover by encrusting animals and abundance of ascidians. Within the areas on the nearshore reef-line, there were two distinct community types characterized by macrophytic plants or sessile invertebrates. The major potential controls of the variation in benthic community structure were different at each of the spatial scales examined. The strong relationship between extrinsic factors and components of the communities suggested that the major potential controls were: (1) exposure to swell at the large scale (between reef-lines); (2) availability of food at the medium scale (within areas on the nearshore reef-line); and (3) biological interactions or responses to microtopography and light climate at the small scale (between and within communities on the nearshore reef-line). (Author's abstract)
W90-01071

**TIDAL CURRENT RIDGES IN THE SOUTHWESTERN YELLOW SEA.**
National Bureau of Oceanography, Qingdao (China). First Inst. of Oceanography.
L. Zhenxia, H. Yichang, and Z. Qinian.
Journal of the Institution of Water and Environmental Management, Vol. 3, No. 3, p 432-437, June 1989. 8 fig, 11 ref.

Descriptors: *Sedimentary structures, *Yellow Sea, *Tidal currents, *Water currents, *Ridging, *Sand waves, Morphology, Tidal rivers, Tidal waves, Tidal energy, Particle size, Sand, Sediment transport, Deltas, Rivers, China.

Large tidal current ridges (tidal sand banks) in the southwestern Yellow Sea are located offshore of northern Jiangsu Province, China. These ridges radiate to a depth of 20-30 meters. The dimensions of the ridge system are about 200 kilometers long and 90 kilometers wide. Their morphology indicates the strong influence of tidal currents. The ridges are composed of well-sorted fine sands (size range is two to four phi). The grain size distributions of the sands show that the sands are transported and deposited by tidal currents. The ridge system formed on the abandoned Yellow River and ancient Yangtze River deltas has an abundant sand supply from the former deltas. Of particular importance is the existence of two tidal wave systems in the Yellow Sea: the rotary tidal wave system in the southern Yellow Sea and the Pacific progressive tidal wave system propagated into the southern ridge area of the southwestern Yellow Sea. Under the interaction of the two tidal wave systems, the huge tidal current system in the southwestern Yellow Sea has formed. (Author's abstract)
W90-01101

**STORM-DOMINATED SEDIMENTATION ON THE INNER SHELF OF THE CANADIAN BEAUFORT SEA.**
Bedford Inst. of Oceanography, Dartmouth (Nova Scotia). Atlantic Geoscience Centre.
For primary bibliographic entry see Field 2J.
W90-01102

**BENTHIC MICROBIAL ACTIVITY IN AN ANTARCTIC COASTAL SEDIMENT AT SIGNY ISLAND, SOUTH ORKNEY ISLANDS.**
Essex Univ., Colchester (England). Dept. of Biology.
For primary bibliographic entry see Field 2H.
W90-01116

**NITROGEN CYCLING BETWEEN SEDIMENT AND THE SHALLOW-WATER COLUMN IN THE TRANSITION ZONE OF THE POTOMAC RIVER AND ESTUARY. II. THE ROLE OF WIND-DRIVEN RESUSPENSION AND ADSORBED AMMONIUM.**
Geological Survey, Reston, VA.
N. S. Simon.
Estuarine, Coastal and Shelf Science ECSSD3, Vol. 28, No. 5, p 531-547, May 1989. 3 fig, 2 tab, 36 ref.

Descriptors: *Cycling nutrients, *Nitrogen cycle, *Suspended sediments, *Rivers, *Potomac River, *Ammonium, *Estuaries, *Transition zone, *Wind-driven currents, Shallow water, Virginia, Adsorption.

During periods of sediment resuspension, desorption of ammonium from sediment solids can be the major pathway for enriching the water column with the ammonium that is produced by bacterial degradation of organic matter in the bottom material. This hypothesis is based on a three-year study of diffusive flux in the transition zone of the Potomac River at a site 35 m from the Virginia shore where the average water-column depth is approximately 1 m over sandy sediment. A diffusion-controlled sampler was used to collect water samples at the interface between the water column and sediment and at several tens of centimeters into the sediment. Interstitial water concentration gradients showed that diffusive flux of ammonium from the sandy shallow-water sediments was approximately 1% of the diffusive flux of ammonium from the silty channel sediments in the same zone of the Potomac River. Organic nitrogen and bound or adsorbed ammonium were the predominant nitrogen forms in the sediment. Adsorbed ammonium concentrations ranged from nondetectable to 3.7 micromoles/g of sediment. Concentrations of adsorbed ammonium per gram of sediment were one to three orders of magnitude more than interstitial water ammonium concentrations. Desorption of ammonium from sediment solids appeared to be the controlling factor in the degree of water-column ammonium enrichment. In laboratory experiments that simulated sediment resuspension, 40-80% of the adsorbed ammonium predicted to desorb did so after approximately 30 min of mixing. Based on calculations for 1 square m to a depth of 4 cm, one resuspension event lasting minutes could mix more ammonium into the water column from desorption of ammonium from sediment solids than could be delivered to the water column by diffusive flux from shallow-water sediments in 10-1000 days and would be comparable to enrichment by ammonium diffusive flux for 5-50 days from channel sediments in the same river zone. (Author's abstract)
W90-01117

**EFFECTIVE WETLANDS POLICY: STICKS OR CARROTS.**
Iowa State Univ., Ames. Dept. of Botany.
For primary bibliographic entry see Field 6E.
W90-01118

**TOXICITY OF NINE BENCHMARK CHEMICALS TO SKELETONEMA COSTATUM, A MARINE DIATOM.**
Dow Chemical U.S.A., Midland, MI. Health and Environmental Sciences.
For primary bibliographic entry see Field 5C.
W90-01182

**OXYGEN UPTAKE KINETICS IN THE BENTHIC BOUNDARY LAYER.**
Chalmers Univ. of Technology, Goeteborg (Sweden). Dept. of Analytical and Marine Chemistry.
For primary bibliographic entry see Field 2H.
W90-01188

**MODELING THE DISTRIBUTION OF ACETATE IN ANOXIC ESTUARINE SEDIMENTS.**
State Univ. of New York at Stony Brook. Marine Sciences Research Center.
A. R. Michelson, M. E. Jacobson, M. I. Scranton, and J. E. Mackin.
Limnology and Oceanography LIOCAH, Vol. 34, No. 4, p 747-757, June 1989. 5 fig, 2 tab, 27 ref. NSF Grant OCE 85-00270; ACS-PRF Grant 15887-G2.

Descriptors: *Salt marshes, *Estuarine environment, *Acetates, *Oxidation, *Kinetics, *Model studies, *Diffusion coefficient, New York, Radioactive tracers.

Concentrations and rates of production and oxidation of acetate were studied in anoxic, estuarine sediments of Flax Pond, New York. Molecular weight separations by Sephadex gel indicated that in some, but not all, cases pore-water acetate consisted of multiple pools. A one dimensional kinetic model that uses measured oxidation rates (C14-labeled acetate conversion to 14CO2) and production rates (MoO4(2-) inhibition experiments) as model parameters was developed. Appropriate diffusion coefficients were calculated with a free-solution value measured in this study. In general, oxidation rate constants estimated from modeled profiles agree well with those from C14 acetate incubation experiments. Results imply that differences in acetate oxidation rates inferred from the two methods can be caused by diffusion of acetate along sharp concentration gradients in sediments. C14 acetate uptake experiments account for such diffusion by using measured steady state acetate concentrations to infer oxidation rates, whereas MoO4(2-) inhibition experiments do not account for in situ acetate diffusion. (Author's Abstract)
W90-01189

**WATER FILTRATION BY DISSIPATIVE BEACHES.**
Oregon Inst. of Marine Biology, Charleston.
A. McLachlan.
Limnology and Oceanography LIOCAH, Vol. 34, No. 4, p 774-780, June 1989. 3 fig, 2 tab, 18 ref.

Descriptors: *Beaches, *Tidal effects, *Surf, *Waves, *Filtration, Energy, Flow, Oregon.

<issipative or low-gradient beaches are expected to filter low volumes of seawater. This idea was tested on the Oregon coast on two high-energy dissipative beaches with medium and fine sand and found to be correct, filtered volumes being 0.1-7 cu m per meter per day. Input was mainly due to tidal effects as most wave energy was dissipated in the surf zone. During a very high-energy event on a high tide, however, filtered volume increased by an order of magnitude as a consequence of increased wave input. (Author's Abstract)
W90-01190

**ENERGY BALANCE OF THE INTERTIDAL ZONE OF WESTERN HUDSON BAY: I. ICE-FREE PERIOD.**
McMaster Univ., Hamilton (Ontario). Dept. of Geography.
A. Silis, W. R. Rouse, and S. Hardill.
Atmosphere-Ocean ATOCDA, Vol. 27, No. 2, p 327-345, June 1989. 13 fig, 3 tab, 21 ref.

Descriptors: *Bays, *Intertidal areas, *Estuaries, *Energy, *Heat transfer, *Hudson Bay, Heat transfer, Albedo, Air-water interfaces, Energy transfer, Solar radiation, Heat flow, Latent heat.

Tower measurements from the intertidal zone taken during the ice-free period on Western Hudson Bay, Canada, between August 1 and September 20, 1985, are reported. Sea and air temperatures showed ranges of 8 and 14 C, respectively, and both were colder during onshore than during offshore winds. Onshore winds were associated with a nearly saturated atmosphere whereas offshore ones were quite dry. Surface albedo was twice as great for low tide as for high tide. The ratio net/solar radiation was 13% less at low tide owing on both the larger albedo and the stronger long-wave radiation loss. Heat fluxes into the bottom sediments were small with net gains in August and net losses in September. During the day, heat storage in the water was large and positive. This occurred even with the tide out, when the ponded water continued to warm. At night, the water gave up heat, both for low and high tide, and especially late in the season. The latent heat flux was always positive and was largest by day during low tide and by night during high tide. The sensible heat flux was positive for onshore winds and often negative for offshore winds. Under all wind directions heat storage constituted 60% of net radiation, the latent heat flux 35% and the remainder was proportioned equally between the sensible heat flux and the flux into the bottom sediments. (Author's abstract)
W90-01216

**ENERGY BALANCE IN THE INTERTIDAL ZONE OF WESTERN HUDSON BAY: II. ICE-DOMINATED PERIODS AND SEASONAL PATTERNS.**
McMaster Univ., Hamilton (Ontario). Dept. of Geography.
W. R. Rouse, S. Hardill, and A. Silis.
Atmosphere-Ocean ATOCDA, Vol. 27, No. 2, p 346-366, June 1989. 9 fig, 5 tab, 13 ref.

Descriptors: *Floating ice, *Intertidal areas, *Estuaries, *Energy, *Ablation, *Seasonal variation, *Hudson Bay, Heat transfer, Energy transfer, Heat flow, Albedo, Bays, Solar radiation.

The energy balance during fast-ice and floating-ice conditions of Western Hudson Bay, Canada, are examined. The rate of ablation of the fast ice was controlled equally by net radiation and air temperature. The ratio of net-solar radiation increased 2.5 times during the ablation period owing to the decrease in ice albedo. Air temperature in the ablation zone was up to 8 C colder than that over the adjacent snow-free terrestrial surface and remained near 0 C for the full ablation period. The sensible heat flux was small and downward (negative), whereas the evaporative heat flux was small and positive. Thus, the energy used in melting the ice was approximately equal to that provided by the net radiation. Above-freezing air temperatures decreased the albedo through surface melting thus increasing net radiation. This combination of higher temperature and large net radiation was associated with offshore winds and resulted in large ablation relative to periods with colder onshore winds. The floating-ice period is one of great variability, owing to changing ice conditions, variable current behavior, tidal cycles and changing wind direction. The intertidal zone acts as a major heat sink, both early and late in the floating-ice period. The turbulent heat fluxes were small and were either positive or negative. Nearly all of the energy from net radiation was used in melting ice and in warming tidal water during high tide and in warming the residual tidal ponds and in melting stranded ice rafts during low tide. For all wind directions throughout study period (May to September), most of the available radiant energy was used to melt ice and to heat the sea water. This is a pattern similar to that of the ice-covered or open sea and dissimilar to that of the adjacent terrestrial environment. It implies that the main energy balance transitions, during onshore air flow, occur at the high tide line. (Author's abstract)
W90-01217

**ESTUARINE OCEANOGRAPHY OF THE VEMBANAD LAKE: PART III. THE REGION BETWEEN COCHIN AND THE 30M DEPTH OFF PORTMOUTH.**
Central Marine Fisheries Research Inst., Cochin (India).
C. P. Ramamirthan, S. Mhthusamy, L. R. Khambadkar, A. Nandakumar, and N. P. Kunhikrishnan.
Indian Journal of Fisheries IJFIAW, Vol. 34, No. 4, p 414-422, 1987. 16 fig, 9 ref.

Descriptors: *Oceanography, *Vembanad Lake, *Coastal waters, *Estuaries, *Arabian Sea, *Plumes, Temperature, Salinity, Oxygen, Lakes, Upwelling, Saline-freshwater interfaces.

The time-distribution patterns of temperature, salinity and oxygen content along the shipping channel from inside the port to a distance of about 15 kilometers out into the Arabian Sea during 1981-1983 are discussed in this third and last part of the estuarine oceanographic study of the Vembanad Lake. The distribution patterns show that hydrologically the nearshore region up to 12 or 15 kilometers off Cochin is more or less identical to the adjacent coastal region, without having any apparent influence from the lake, during the dry months January to May. During the wet months, however, the discharge from the lake, characterized by suspended sediments, spreads as a plume, over highly saline and cold upwelled water, turning the region into an intermittent estuary. Although the end of the plume can often be pinpointed around the 30 meter depthline, by a sharp change of color and filaments formed of floating objects of land and freshwater origin, the presence of an actual plume front is doubtful because of the weak surface convergence then occurring in a broad area off Cochin. The upwelling, changes in temperature and the dissolved oxygen were related to the intensity of the southwest monsoon. (Author's Abstract)
W90-01271

**CARBON-CONTROLLED NITROGEN CYCLING IN A MARINE 'MACROCOSM': AN ECOSYSTEM-SCALE MODEL FOR MANAGING CULTURAL EUTROPHICATION.**
Hawaii Inst. of Marine Biology, Honolulu.
S. V. Smith, and J. T. Hollibaugh.
Marine Ecology Progress Series MESEDT, Vol. 52, No. 2, p 103-109, March 2, 1989. 1 tab, 29 ref.

Descriptors: *Limiting nutrients, *Marine environment, *Nitrogen cycle, *Model studies, *Eutrophication, Denitrification, Primary productivity, Tomales Bay, California, Coastal waters, Geochemistry, Macrocosms.

Both data presented for Tomales Bay (California) and general geochemical reasoning provide evidence to suggest that nearshore marine environments tend to be net heterotrophic by a small margin, and that these systems oxidize on the order of 1% of their primary production by denitrification. The rate of denitrification can be interpreted to be a simple stoichiometric function of the margin of heterotrophy. Carbon oxidation by denitrification is trivial to the total C budget, but fixed N loss is sufficient to cause apparent N-limitation of primary production in these systems. It is suggested that heterotrophic C metabolism causes the apparent N limitation of primary production, and that control of the N cycle by C has important implications for environmental management. (Author's abstract)
W90-01287

**AUTOTROPHIC PICOPLANKTON DYNAMICS IN A CHESAPEAKE BAY SUB-ESTUARY.**
Virginia Inst. of Marine Science, Gloucester Point.
R. T. Ray, L. W. Haas, and M. E. Sieracki.
Marine Ecology Progress Series MESEDT, Vol. 52, No. 3, p 273-285, March 22, 1989. 8 fig, 4 tab, 62 ref. NSF grant OCE 81-10396.

Descriptors: *Estuaries, *Chesapeake Bay, *Plankton, *Dynamics, *Autotrophy, Picoplankton, Biomass, Tidal effects, Primary productivity.

The contribution of picoplankton (0.2 to 0.3 microm) to phytoplankton biomass and production was examined in a tributary of the Chesapeake Bay, USA, during summer 1985. The water column in this tributary oscillates with the spring-neap tidal cycle (homogeneously mixed and stratified, respectively) which permits observation of the effects of water column stability on phyto-

plankton dynamics. Picoplankton made up 7% of the seasonal autotrophic biomass, with a peak contribution of 10 to 14% in the first half of July. Phycocyanin-rich chroococcoid cyanobacteria, visible only with fluorescence microscopy using green light excitation (510 to 560 nm), numerically dominated the picophytoplankton, being 8 times more abundant than the phycoerythrin-containing cyanobacteria. Together these two cyanobacteria types represented 51% of the picophytoplankton biomass, and exhibited a pronounces fortnightly cycle in abundance which coincided with the spring-neap tidal cycle. Picoplankton were responsible for 9% of the primary production at 293 microE/sq m/s and 13% at 28 to 43 microE/sq m/s, averaged over the study period. Chlorophyll-specific uptake rates by the larger autotrophs (seasonal mean, 5.2 microg C/microg chl a/h)were significantly higher than the picoplankton (seasonal mean, 2.5 microg C/microg chl a/h) at 293 microE/sq m/s, but not at 28 to 43 microE/sq m/s. A simple model based on spring-neap, tidally-induced oscillations in mixed layer depth, and its regulation of light availability, produced cycles in cyanobacterial growth rates which could partially explain the observed cycles in abundance. These results emphasize the importance of physical processes occurring on time scales of days or weeks in regulating plankton biomass and primary production in estuarine environments. (Author's abstract)
W90-01288

**STRUCTURE AND FUNCTION IN A MODEL COASTAL ECOSYSTEM: SILICON, THE BENTHOS AND EUTROPHICATION.**
Rhode Island Univ., Narragansett. Marine Ecosystems Research Lab.
P. H. Doering, C. A. Oviatt, L. L. Beatty, V. F. Banzon, and R. Rice.
Marine Ecology Progress Series MESEDT, Vol. 52, No. 3, p 287-299, March 22, 1989. 3 fig, 6 tab, 56 ref. EPA grant CR 812487-01-1.

Descriptors: *Coastal waters, *Ecosystems, *Eutrophication, *Nutrients, Nitrogen, Silicon, Benthos, Mesocosms.

To test the hypothesis that the presence or absence of a link between the water column and benthos is likely to be important in relatively shallow coastal waters, a series of nutrients were added to the large outdoor mesocosm systems of the Marine Ecosystems Research Laboratory (Rhode Island). Nutrient-treated tanks received daily additions of nitrogen and phosphorous in equal magnitude and proportion. One series of tanks, however, received a nutrient mix with a N:Si ratio of 14:1 while for another group this ratio was 1:1. Lowering the N:Si ratio (14:1 to 1:1) in nutrient (N, P, Si) additions to large (13 cu m) outdoor mesocosms with and without an intact benthic community generally resulted in higher standing stocks of diatoms. An enhanced diatom flora during the year-long experiment was not accompanied by a concomitant reduction in the extent of eutrophication caused by nutrient loading, as judged by oxygen concentration and metabolism or by chlorophyll a biomass. Enhanced growth of Atlantic menhaden Brevoortia tyrannus in the low N:Si ratio treatment suggested that diatoms promote transfer of energy to higher trophic levels. Removal of the benthic community and associated sediments had a dramatic effect on pelagic community structure. Zooplankton were holoplanktonic in character and high trophic levels were dominated by ctenophores, medusae, chaetognaths and fish. In the presence of an intact benthos, the zooplankton had a larger meroplanktonic component and higher trophic levels were dominated by larvae of benthic adults (anemones, shrimp) or temporary planktonic adults (mysids). (Miller-PTT)
W90-01289

**MICROAUTORADIOGRAPHIC STUDY OF THYMIDINE UPTAKE IN BRACKISH WATERS AROUND SAPELO ISLAND, GEORGIA, USA.**
Universidad Autonoma de Barcelona (Spain). Dept. of Genetics and Microbiology.
C. Pedros-Alio, and S. Y. Newell.
Marine Ecolgy Progress Series MESEDT, Vol. 55, No. 1, p 83-94, July 6, 1989. 6 fig, 2 tab, 55 ref. CICYT grant PB87-0183.

Descriptors: *Bacterial physiology, *Radiometry, *Brackish water, *Absorption, Georgia, Thymidine, Autoradiographic studies, Plankton.

Total cell numbers, thymidine uptake rates, and percent of bacteria labeled with thymidine were determined in a variety of brackish water environments around Sapelo Island. Cell numbers were high compared to other aquatic habitats and varied between 4000000 and 32000000 cells/ml (average 10700000 cells/ml). Thymidine uptake rates were also among the highest published values, up to 425 fmol thymidine/ml/h (average 213 fmol thymidine/ml/h). Despite high abundance and activity, the percentage of cells labeled with thymidine (as determined by microautoradiography) was usually low, ranging from 1 to 69% (average 16%). Brackish-water cultures studied in the laboratory showed, at most, 57% of the bacteria labeled even during exponential growth. It is concluded that many actively growing cells did not take up thymidine in these waters. (Author's abstract)
W90-01291

**CARBON AND NITROGEN RESOURCES AVAILABLE TO KELP BED FILTER FEEDERS IN AN UPWELLING ENVIRONMENT.**
Cape Town Univ. (South Africa). Dept. of Zoology.
P. J. Fielding, and C. L. Davis.
Marine Ecolgy Progress Series MESEDT, Vol. 55, No. 1, p 181-189, July 27, 1989. 1 fig, 4 tab, 47 ref.

Descriptors: *Carbon, *Nitrogen, *Upwelling, *Kelps, *Coastal waters, South Africa, Kelp bed filter feeders, Seasonal variation, Nutrients.

Environmental variables and summer and winter particulate concentrations in the water column of a kelp bed in an upwelling region on the western Cape coast of South Africa, were measured daily to assess short-term fluctuations. There were significant differences between the summer and winter upwelling index, water temperature and wave height. Summer particulate carbon and nitrogen concentrations of 533 microg/l and 66 microg/l, respectively, were lower than the winter levels of 764 micro c/l and 79 microg N/l. However, summer upwelling events did not reduce particulate carbon and nitrogen to the very low levels that might be expected from previous studies of chlorophyll concentrations in the kelp bed. Large waves resulted in C:N ratios that were significantly higher in winter than in summer ($p < 0.01$), and during continuous winter downwelling, large proportion of the particulate material in the water column was of macrophyte rather than phytoplankton origin. In summer, the carbon and nitrogen load was most highly correlated with temperature, while wind and wave size were the most important factors affecting particulate concentrations in winter. Mean particle organic concentrations were 380 microg C/l and 43 microg N/l and these compare well with concentrations of 301 mcirog C/l and 41 microg N/l estimated from previous primary production studies. The estimated carbon demands of Choromytilus meridionalis and Aulacomya ater, 2 mussels that commonly occur in kelp beds on the west coast, could be met in winter and summer by the particulate organic component in the kelp bed water column. Particulate nitrogen resources probably meet most of the nitrogen requirements of the two mussels. (Author's abstract)
W90-01293

**TIDAL EXCHANGE IN LAKE SHINJI UNDER LOW DISCHARGE CONDITIONS.**
Shamine Prefectural Inst. of Public Health and Environmental Science, Matsue (Japan).
For primary bibliographic entry see Field 2H.
W90-01295

**PATTERNS OF CARBON ISOTOPIC VARIABILITY IN EELGRASS, ZOSTERA MARINA L., FROM IZEMBEK LAGOON, ALASKA.**
Tennessee Univ., Knoxville. Dept. of Geological Sciences.
L. W. Cooper.
Aquatic Botany AQBODS, Vol. 34, No. 4, p 329-339, August 1989. 6 fig, 2 tab, 37 ref. NSF grant OCE 77-27050.

Descriptors: *Sea grasses, *Plant physiology, *Carbon dioxide, *Isotope studies, *Photosynthesis, Zostera, Anoxia, Sediments, Bicarbonates, Izembek Lagoon, Alaska.

Zostera marina L. eelgrass, from Izembek Lagoon, Alaska, became isotopically less depleted in C13 over the course of a transect into more anoxic sediments. Plants growing in the more anoxic sediments had been previously documented to have enhanced lacunal development and higher concentration of CO2 within the lacunae. It was hypothesized that these patterns facilitated recycling and internal use of lacunal CO2 and were responsible for the carbon isotope variation observed. A number of other possible influences on isotopic variability, including relative water motion, biochemical fractionation associated with seasonal variability, isotopic variability in the dissolved inorganic carbon pool, temperature, and light intensity were considered, but not found to be significant. Uncertainties, however, are the proportions of bicarbonate and dissolved CO2 used in photosynthesis. An intertidal eelgrass sample appeared to be influenced isotopically by CO2 exposure from the atmosphere. Of three plant organs samples, leaves had the highest content of C13, followed by roots and rhizomes. Sediment organic delta-C13 values indicated that eelgrass detritus contributes significantly to sediment organic carbon. Higher sediment organic C/N ratios toward the anoxic end of the transect confirm that those sediments contain increasingly more re-worked detrital material. (Author's abstract)
W90-01308

**LONG-TERM CHANGE IN THE COASTAL BIOTA OF HATAKEJIMA ISLAND, (JAPANESE).**
1-10-18 Wakamatsu-cho, Fuchi-shi, Tokyo 183, Japan.
For primary bibliographic entry see Field 5C.
W90-01325

**OPTIMIZATION OF THE EWENS/CASWELL NEUTRAL MODEL PROGRAM FOR COMMUNITY DIVERSITY ANALYSIS.**
British Museum of Natural History, London (England). Biometric Section.
For primary bibliographic entry see Field 7C.
W90-01326

**SIGNIFICANCE OF ADVECTION FOR THE CARRYING CAPACITIES OF FJORD POPULATIONS.**
Bergen Univ. (Norway). Dept. of Marine Biology.
D. L. Aksnes, J. Aure, S. Kaartvedt, T. Magnesen, and J. Richard.
Marine Ecology Progress Series MESEDT, Vol. 50, No. 3, p 263-274, January 2, 1989. 7 fig, 5 tab, 21 ref.

Descriptors: *Fjords, *Nutrients, *Phytoplankton, *Zooplankton, *Advection, *Predation, Water currents, Vertical distribution, Norway.

Advective rates of nutrients, phytoplankton and zooplankton were examined for the Masfjord, western Norway, in June and October 1985. The advective contribution to the phytoplankton biomass formation was clearly less than the local growth. Advection of nutrients, even below the photic zone, may have large implications for the new production of the fjord. The highest renewal rate (13.6%/day) due to advection was obtained for the mesozooplankton in June. While 20% of this renewal was due to water advection alone, 80% was due to the combined effect of the current profile and the vertical distribution of the mesozooplankton. Thus transport of mesozooplankton may exceed local growth significantly. The deep basin (494 m) of the fjord serves as a refuge for

resident mesozooplankton and micronekton populations predating on mesozooplankton. Analysis suggests that such predators may be more sensitive to a change in the advective rate than to a similar change in the prey growth rate. Advection may be an important factor underlying the carrying capacity of mesozooplankton predators in fjords. (Author's abstract)
W90-01327

**IN SITU ACOUSTIC MEASUREMENTS OF MARINE GRAVEL THRESHOLD AND TRANSPORT.**
Proudman Oceanographic Lab., Birkenhead (England).
For primary bibliographic entry see Field 2J.
W90-01357

**DEPOSITIONAL PROCESSES ON AN ANCIENT AND MODERN MUDDY SHELF, NORTHERN CALIFORNIA.**
Washington Univ., Seattle. Dept. of Geological Sciences.
For primary bibliographic entry see Field 2J.
W90-01358

**DISTRIBUTION OF AMPHIPODA IN A BRACKISH-WATER LAGOON IN GREECE.**
Athens Univ. (Greece). Zoological Lab. and Museum.
A. Nicolaidou, and M. Karadiri.
Marine Ecology MAECDR, Vol. 10, No. 2, p 131-139, 1989. 4 fig, 1 tab, 32 ref.

Descriptors: *Amphipods, *Greece, *Benthic fauna, *Aquatic animals, *Estuarine environment, Spatial distribution, Species composition, Competition, Population density, Aquatic habitats, Coastal waters.

The distribution of the benthic Amphipoda was studied in the brackish-water lagoon Mozoma of the Amvrakikos Bay, Ioninan Sea, Greece. Ten stations were sampled from June 1981 to 1982 at approximately bimonthly intervals. A total of 5600 specimens were collected and identified representing five families and eleven species. The species Gammarus crinicornis, Microdeutopus bifidus, Corophium rotundirostris, and Erichthonius difformis were reported for the first time in Greece. From the most abundant species, G. insensibilis and Dexamine spinosa showed a preference for stations with high plant biomass, but their maximum population densities did not coincide in either space or season. M. gryllotalpa was distributed throughout the lagoon, and its maximum abundance did not coincide with that of G. insensibilis and D. spinosa. Corophium insidiosum had a limited distribution and coexisted with M. gryllotalpa. It is suggested that the distribution of amphipods in the lagoon is governed and modified by interspecific competition. (Author's abstract)
W90-01380

**DESCRIPTIVE ANALYSIS AND CLASSIFICATION OF BENTHIC COMMUNITIES IN SOME MEDITERRANEAN COASTAL LAGOONS (CENTRAL ITALY).**
Universita degli Studi 'La Sapienza', Rome (Italy). Dipt. di Biologia Animale e dell 'Uomo.
M. F. Gravina, G. D. Ardizzone, F. Scaletta, and C. Chimenz.
Marine Ecology MAECDR, Vol. 10, No. 2, p 141-166, 1989. 9 fig, 9 tab, 46 ref.

Descriptors: *Water pollution effects, *Italy, *Benthic fauna, *Estuarine environment, *Polychaetes, *Amphipods, *Midges, *Mollusks, Salt tolerance, Aquatic habitats, Species diversity, Population density, Eutrophication, Species composition, Coastal waters.

The macrobenthos of five lagoons of Central Italy (Fogliano, Monaci, Caprolace, Fondi, and Lungo) was investigated from May 1982 to January 1984. The macrobenthic communities showed a remarkable degree of complexity and variability. A total of 196 taxa and almost 124,000 specimens were collected. Polychaetes dominated in species richness and abundance, while amphipods ranked second, and chironomids and mollusks ranked third and fourth, respectively. The highest number of species (144) and greatest diversity (4.23)--and correlated minimum redundancy--were found in the lagoon where the marine influence was strongest (Caprolace). In contrast, the maximum number of individuals (83,858) and minimum species richness (34) were found in Fondi, which is characterized by minimal exchange with the sea. The faunal differentiation appeared to be mainly due to the different degree of water exchange with the sea. Continental eutrophic inputs also appeared to be an important factor influencing the benthic communities, especially in Monaci and Lungo. Lagoons and taxa were grouped according to similarity by a cluster analysis. The benthic communities were composed of three principal groups of species: (1) marine species common in sheltered coastal areas; (2) lagoon and halolimnobic species, frequently found in enclosed situation; and (3) opportunistic species, with high ecological tolerance, characteristic of organically enriched and non-oxygenated environments. (Author's abstract)
W90-01381

**FEASIBILITY OF USING SATELLITES FOR DETECTION OF KINETICS OF SMALL PHYTOPLANKTON BLOOMS IN ESTUARIES: TIDAL AND MIGRATIONAL EFFECTS.**
Versar, Inc., Columbia, MD.
For primary bibliographic entry see Field 7B.
W90-01393

**SORPTION OF BENZIDINE, TOLUIDINE, AND AZOBENZENE ON COLLOIDAL ORGANIC MATTER.**
Louisiana State Univ., Baton Rouge. Inst. for Environmental Studies.
For primary bibliographic entry see Field 5B.
W90-01505

**GEOCHEMISTRY OF DISSOLVED CHROMIUM--ORGANIC-MATTER COMPLEXES IN NARRAGANSETT BAY INTERSTITIAL WATERS.**
Rhode Island Univ., Narragansett. Graduate School of Oceanography.
For primary bibliographic entry see Field 5A.
W90-01511

**HYDROCARBON-BASED COMMUNITIES IN THE NORTH SEA.**
Norske Stats Oljeselskap A/S, Stavanger (Norway).
M. Hovland, and E. Thomsen.
Sarsia SARIA3, Vol. 74, N. 1, p 29-42, 1989. 10 fig, 15 ref.

Descriptors: *Hydrocarbons, *Benthos, *Nekton, *Ocean bottom, *Plankton, *North Sea, Benthic fauna, Sediment-water interfaces, Aquatic life, Benthic environment, Zooplankton, Marine biology, Hydrocarbon seepage, Videotape, Sedimentary structures, Distribution patterns, Marine bacteria, Food chains, Fish.

Surveys of submarine pipeline routes, platform sites, and the seabed in the North Sea indicate that hydrocarbon-based communities occur in connection with gas-related seabed features, that is pockmarks and 'mottled' seabed. Sediments beneath the larger patches of 'mottled' seabed are gas-charged and it is assumed that slow seepage (micro-seepage) of pore-water and hydrocarbons occurs from these. Smaller patches named 'eyed pockmarks' are also suspected of representing gas-seepage locations. The distribution of the benthos, nekton, and plankton associated with 'mottled' seabed in the Tommeliten area and specific pockmarks in the Holene and Gullfaks areas was studied by videotape recordings. Besides the faunal elements, biogenic sedimentary structures were recorded. A remarkable visible difference between the environment outside and inside the 'mottled' seabed areas and the pockmark depressions, with regard to faunal distribution, abundance, and diversity, is demonstrated. Seston (including plankton) increases as the deepest areas of the pockmarks are approached, probably as a response to hydrocarbon micro-seepage or resuspension by euphausids. The zooplankton probably feed on bacteria and other organic matter from the sediment. Presence of suspected bacterial mats on the seabed in the gas-related areas may sustain this hypothesis and suggests that the local community could be based partly on hydrocarbons. The plankton is a food resource for suspension-feeding/carnivorous benthos, which may explain the abundance of anthozoans within the pockmarks. Additional benthos may serve as food for some fishes, which again attract larger fishes, explaining their higher abundance in the pockmarks. (Author's abstract)
W90-01732

**SPREADING OF HAZARDOUS SUBSTANCES IN THE SOUTHERN GERMAN BAY AND THE ELBE-ESTUARY AFTER DISCHARGE FROM SHIPS. AN ECOLOGICAL RISK ASSESSMENT BY NUMERICAL MODEL CALCULATIONS (AUSBREITUNG VON WASSERGEFAHRDENDEN STOFFEN IN DER SUDLICHEN DEUTSCHEN BUCHT UND IM ELBE-ASTUAR NACH FREISETZUNG DURCH SCHIFFE).**
For primary bibliographic entry see Field 5B.
W90-01738

# 3. WATER SUPPLY AUGMENTATION AND CONSERVATION

## 3A. Saline Water Conversion

**URBAN WATER SUPPLY IN ARID ENVIRONMENT-EXAMPLES FROM THE ARABIAN PENINSULA.**
Dornier-System G.m.b.H., Friedrichshafen (Germany, F.R.). Dept. for Regional and Environmental Planning.
For primary bibliographic entry see Field 5F.
W90-01629

**REMOVAL OF NITRATE FROM GROUNDWATER BY A DIAPHRAGM PROCESS WITH SIMULTANEOUS REMOVAL OF THE CONCENTRATES PRODUCED WITH LITTLE RESIDUE (NITRATENTFERNUNG AUS GRUNDWAESSERN DURCH MEMBRANVERFAHREN BEL GLEICHZEITIGER, RUECKSTANDSARMER ENTSORGUNG DER ANFALLENDEN KONZENTRATE).**
Technische Hochschule Aachen (Germany, F.R.). Fakultaet fuer Maschinenwesen.
For primary bibliographic entry see Field 5F.
W90-01784

## 3B. Water Yield Improvement

**FOREST HARVEST, SNOWMELT AND STREAMFLOW IN THE CENTRAL SIERRA NEVADA.**
Pacific Southwest Forest and Range Experiment Station, Berkeley, CA.
For primary bibliographic entry see Field 4D.
W90-01458

**SNOW REDISTRIBUTION: STRIP CUTS AT YUBA PASS, CALIFORNIA.**
Pacific Southwest Forest and Range Experiment Station, Berkeley, CA.
For primary bibliographic entry see Field 4B.
W90-01459

**OVER-IRRIGATION OF PADDY FIELDS FOR THE PURPOSE OF ARTIFICIALLY RECHARGING GROUNDWATER IN THE CONJUNCTIVE USE SCHEME OF THE CHO-SHUI RIVER BASIN.**
National Taiwan Univ., Taipei. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 3F.
W90-01838

## 3C. Use Of Water Of Impaired Quality

**IN VITRO SELECTION FOR SALINITY AND REGENERATION OF PLANTS IN RICE.**
Osmania Univ., Hyderabad (India). Dept. of Genetics.
K. Subhashini, and G. M. Reddy.
Current Science CUSCAM, Vol. 58, No. 10, p 584-586, May 20, 1989. 1 fig, 1 tab, 6 ref.

Descriptors: *Saline water, *Impaired water use, *Salt tolerance, *Rice, *Sodium chloride, *Seawater.

Five genotypes of rice plants were screened for salt tolerance in callus cultures, not only with NaCl but also with different concentrations of seawater directly, and the regeneration of plants from these salt-tolerant callus cultures. Mature seeds of rice cultivars Basmati 370, Pakistani Basmati, Chittimutyalu, Gopal Bhog and Randhunipagalu were dehusked, sterilized, washed and presoaked. Cultured embryos were kept under continuous white fluorescent light and maintained for 3 weeks at 26 C. Profusely growing calli were inoculated onto media containing 1, 2 or 3% NaCl, or 25, 50 or 75% seawater with 2 mg/l 2,4-D. There was a decrease in callus growth with increasing salt concentrations. Salt-exposed calli usually turned brown, indicating necrosis. Portions of calli which grew were subcultured onto fresh salt/seawater media. The selection process was repeated three times. Based on regeneration ability, the cultivar Randhunipagalu was more sensitive to salt. Basmati 370, Chittimutyalu and Gopal Bhog were grown to maturity and the seeds collected. Seedlings from a second tissue culture were subjected to 0.75% NaCl throughout the life cycle. During early stages of growth, the plants under stress showed certain changes in morphology compared to control plants. The leaves were generally narrow under salt stress. The present studies clearly suggest the genotype dependence of salt tolerance. (Mertz-PTT)
W90-01148

**IMPLEMENTATION STRATEGIES FOR SALINITY PROJECTS.**
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5G.
W90-01351

**WASTE WATER IRRIGATION SUITED TO THE ENVIRONMENT AS SHOWN BY THE EXAMPLE OF THE 'ABWASSERVERBAND WOLFSBURG'.**
Technische Univ. Braunschweig (Germany, F.R.). Inst. fuer Geologie.
J. Wolff, J. Ebeling, A. Muller, and H. Wacker.
IN: Hydrological Processes and Water Management in Urban Areas. Proceedings of the International Symposium 24-29 April 1988, Duisburg, West Germany. International Hydrological Programme of UNESCO Publication, 1988. p 599-606, 3 fig, 2 tab, 4 ref.

Descriptors: *Wastewater irrigation, *Land disposal, *Water quality control, Groundwater quality, Pollutant identification, Monitoring, Chemical analysis, Wastewater management, Soil contamination.

Changes in the chemistry of groundwater by the influence of wastewater land treatment is discussed based on research conducted at the 'Abwasserrverband Wolfsburg are of south-east Lower Saxony. The results of a 4-year research program shows: (1) the need to pretreat wastewater, and eliminate burdening and harmful substances (e.g. heavy metals) by purification plants; (2) the necessity of irrigation (soil, climate) and the economical necessity of additional watering; (3) the need for continuous groundwater monitoring; (4) the need for continual chemical analysis of wastewater quality; and (5) the need for continuing analysis of soil and plants for possible enrichment of harmful substances. (See also W90-01612) (Lantz-PTT)
W90-01679

**WATER AND THE URBAN LANDSCAPES IN THE TROPICS: THE EXAMPLE OF LAGOS, NIGERIA.**
Lagos Univ. (Nigeria). Dept. of Geography.
O. Ojo.
IN: Hydrological Processes and Water Management in Urban Areas. Proceedings of the International Symposium 24-29 April 1988, Duisburg, West Germany. International Hydrological Programme of UNESCO Publication, 1988. p 691-700, 2 fig, 4 ref.

Descriptors: *Urban hydrology, *Tropical regions, *Water resources development, *Nigeria, Climatology, Geology, Lagos, Urban areas.

Water, as a component and a factor of the climatic and hydroclimatic environment, has always played a significant role in the climate of Lagos, Nigeria. Since not much work has been done to examine this role, a study was conducted on this important subject, particularly as related to the tropical environment. The study examines the locational characteristics of Lagos within the hydrospheric environment, and the advantages and disadvantages of these locational characteristics with respect to the significance of water as a component and a factor of the environment. Emphasis is placed on: (1) the macro-, meso-, and micro-scale climatic and hydroclimatic characteristics; and (2) the temporal and spatial distribution of thermal comfort or discomfort and health hazards in the city. Finally, the study examines the challenge posed by the study of water as a factor in urban landscapes and suggests possible approaches to meeting the challenge. (See also W90-01612) (Lantz-PTT)
W90-01689

## 3D. Conservation In Domestic and Municipal Use

**TOWARDS A SPECIFIC APPROACH OF URBAN HYDROLOGY IN AFRICA.**
Montpellier-2 Univ. (France).
For primary bibliographic entry see Field 5G.
W90-01638

**URBAN DRAINAGE IN PARAMARIBO, SURINAME.**
Ministry of Public Works, Telecommunications and Construction, Paramaribo (Surinam).
For primary bibliographic entry see Field 5D.
W90-01639

**REDUCTION MEASURES FOR FLOOD RUNOFF AND THE ESTIMATION OF THE EFFECTIVE RAINFALL OF THE SMALL RIVERS IN TOKYO METROPOLIS.**
Institute of Civil Engineering, Tokyo (Japan).
For primary bibliographic entry see Field 2A.
W90-01644

**IRRATIONALITY IN DECISION MAKING PROCESS EXEMPLIFIED BY APPLIED POLICIES CONCERNING STORMWATER DETENTION IN DIFFERENT COUNTRIES.**
Lund Univ. (Sweden). Dept. of Water Resources Engineering.
For primary bibliographic entry see Field 6A.
W90-01646

**RECENT TRENDS IN THE REAL TIME CONTROL OF URBAN DRAINAGE SYSTEMS.**
Hanover Univ. (Germany, F.R.). Inst. fuer Grundbau, Bodenmechanik und Energiewasserbau.
For primary bibliographic entry see Field 5D.
W90-01649

**COMBINED SEWER OVERFLOW ABATEMENT BY ON-SITE DETENTION, INFILTRATION, AND RE-USE.**
Hanover Univ. (Germany, F.R.). Inst. fuer Grundbau, Bodenmechanik und Energiewasserbau.
For primary bibliographic entry see Field 5D.
W90-01650

**AREA RETENTION USED AS AN ELEMENT FOR THE DESIGN OF URBAN CATCHMENTS.**
Ingenieurburo fuer Wasserwirtschaft, Dreieich, West Germany.
For primary bibliographic entry see Field 4A.
W90-01652

**REVIEW OF PROGRAM 'URBAN HYDROLOGICAL R AND D IN NORWAY 1983-1987'.**
Norges Vassdrags- og Elektrisitetsvesen, Oslo.
For primary bibliographic entry see Field 5D.
W90-01653

**CONCEPTS OF URBAN DRAINAGE AND FLOOD PROTECTION ADOPTED FOR THE CITY OF TOKYO.**
Shibaura Inst. of Tech., Tokyo (Japan).
For primary bibliographic entry see Field 4A.
W90-01654

**GROUNDWATER RESPONSE IN THE URBAN SECTORS OF CAIRO ENVIRONS, EGYPT.**
Qatar Univ., Doha. Dept. of Geology.
For primary bibliographic entry see Field 4C.
W90-01660

**POSSIBILITIES FOR GROUNDWATER DEVELOPMENT FOR THE CITY OF JAKARTA, INDONESIA.**
Bundesanstalt fuer Geowissenschaften und Rohstoffe, Hanover (Germany, F.R.).
For primary bibliographic entry see Field 2F.
W90-01669

**GROUNDWATER AND SURFACE WATER QUALITY IN AND AROUND BHOPAL CITY IN INDIA.**
Central Ground Water Board, Bhopal (India).
For primary bibliographic entry see Field 4C.
W90-01671

**METHODS OF REDUCING THE STORM SEWAGE OVERFLOWS.**
TAUW Infra Consult B.V., Deventer (Netherlands).
For primary bibliographic entry see Field 4A.
W90-01678

**CHALLENGES OF WATER SUPPLY DEVELOPMENT IN THE URBANISED ISLAND OF PENANG, MALAYSIA.**
Brunei Univ., Bandar Seri Begawan. Dept. of Geography.
K. C. Goh.
IN: Hydrological Processes and Water Management in Urban Areas. Proceedings of the International Symposium 24-29 April 1988, Duisburg, West Germany. International Hydrological Programme of UNESCO Publication, 1988. p 657-665, 1 fig, 7 ref.

Descriptors: *Malaysia, *Water conveyance, *Water resources development, *Water management, Water supply, Costs, History, Industrial development, Penang Island.

Penang Island has one of the oldest water supply systems in Malaysia. Historical, physiographic and economic factors have imposed considerable constraints to the development of the water supply over the past two decades in order to meet drastic increases in domestic and industrial consumption concomitant with a high degree of urbanization and industrialization. This paper examines these constraints as well as steps taken to meet these challenges. Organizational restructuring of the water supply agency as well as infrastructural development have resulted in the island having a well and efficiently managed water supply system. However, while the water needs for the next 10-12 years are well taken care of, there still remains

other challenges that require equally urgent attention. One main task is to replace old pipelines experiencing sulfate attack, as well as to replace obsolete instruments with new ones with higher operating ranges. Another feature is the increasing costs of water production from poorer quality sources some distance from the island. The maximum use of water from the catchments on the island will have to be made. With increased production costs comes the need to increase water tariffs and hence a strategy for restructuring such increases is mandatory. Affordability, rather than unlimited subsidies, should be guideline. By providing for lower charges for less consumption and by providing judicious cross-subsidies, the criterion that a man on the poverty line should not pay more than 4% of his income for the water he consumes, can still be met. (See also W90-01612) (Lantz-PTT)
W90-01685

**RE-NATURATION OF WATERCOURSES IN THE NORTH RHINE-WESTPHALIAN INDUSTRIAL REGION.**
Emschergenossenschaft und Lippeverband, Essen (Germany, F.R.).
For primary bibliographic entry see Field 5G.
W90-01688

**WATER IN THE LANDSCAPE OF A TOWN USING THE EXAMPLE OF GDANSK AND THE GDANSK CONURBATION.**
Gdansk Technical Univ. (Poland). Dept. of Architecture.
H. Sienkowska.
IN: Hydrological Processes and Water Management in Urban Areas. Proceedings of the International Symposium 24-29 April 1988, Duisburg, West Germany. International Hydrological Programme of UNESCO Publication, 1988. p 701-708, 3 fig.

Descriptors: *Urban hydrology, Gdansk, Poland, Recreation, Parks, Landscaping, Urbanization.

The landscape of a town is the result of its location and its historical development. Water, together with buildings and vegetation, formed the characteristic image of towns located on river banks or coasts, but the role of water has changed throughout time. Gdansk, Poland, was founded at the confluence of the Mottawa and the Vistula Rivers. These rivers played an important role in the landscape of the town until the 19th century when it expanded toward the sea coast. In the last three decades, Gdansk together with the neighboring towns of Sopot and Gdynia, formed a conurbation. The linear shape of the conurbation provides the inhabitants of the residential areas with the opportunity for direct contact with the recreational area of the green belt. It parallels the main axis of the built-up zone and is connected by transverse routes to the green coastal belt. On the other hand, the demand for workers in this maritime economy has resulted in the developing trends of increasing population and urbanization. In the Gdansk Conurbation there are some commonly known and recognized pedestrian areas for tourists and recreation, dedicated mostly to visual consumption of the sea attractions. The factors which hinder an unlimited growth of the towns around the Gdansk Bay include: (1) the land formation that is difficult to build upon; (2) the problems of supplying the towns with water; and (3) maintaining the sewerage and remote heating systems. (See also W90-01612) (Lantz-PTT)
W90-01690

**LAKES REMAINING FROM GRAVEL EXCAVATIONS FOR RECREATIONAL AND SPORTS USE IN LARGE CITIES.**
Zagreb Univ. (Yugoslavia).
F. Wenzler.
IN: Hydrological Processes and Water Management in Urban Areas. Proceedings of the International Symposium 24-29 April 1988, Duisburg, West Germany. International Hydrological Programme of UNESCO Publication, 1988. p 709-716, 1 photo.

Descriptors: *Water resources development, *Lakes, *Recreation, *Urban planning, Artificial lakes, Water quality, Ecosystems, Zagreb, Yugoslavia, Case studies.

Many European cities developed in the vicinity of big rivers are laying on alluvial detritus of gravel and sand which are excavated as building materials. Artificial lakes created by these excavations could be improved for recreational and sports use. Some of the difficulties faced when making these improvements are: (1) formation of shorelines; (2) spatial organization of hinterland; (3) water quality; and (4) improving both water and land ecosystems. One of these lakes in the Zagreb, Yugoslavia vicinity, the Recreational and Sports Center Jarun (230 hectares), is presented in this paper as a case study of this land of recreational development. (See also W90-01612) (Lantz-PTT)
W90-01691

**EMSCHER RIVER-- A MODEL OF INTEGRATED WATER MANAGEMENT IN AN URBANIZED AREA: PROBLEMS AND CHALLENGES.**
Emschergenossenschaft und Lippeverband, Essen (Germany, F.R.).
G. Annen.
IN: Hydrological Processes and Water Management in Urban Areas. Proceedings of the International Symposium 24-29 April 1988, Duisburg, West Germany. International Hydrological Programme of UNESCO Publication, 1988. p 721-728, 3 fig.

Descriptors: *Water pollution treatment, *West Germany, *Water management, *Urban areas, *Emscher River, *Water quality control, Costs, Water treatment, Turbidity.

In the industrial center of West Germany (the Ruhrdistrict) difficult water problems arose from the quick industrial and population growth of the second part of the last century. Structures of an integrated water management scheme had been established in those years which has proved to be effective until now. However, new influences and developments require further progress to keep the system in an efficient and acceptable state. An additional treatment plant in the Dortmund area and perhaps one or two more pretreatment plants will not substantially change the Emscher system. The Emscher Mouth Plan will continue to work as the main and final treatment, and to be responsible for a well cleaned effluent to the Rhine River. The Emscher River itself will continue to be the main sewer of the district. Its pollution can be kept below the limits of nuisance danger but cannot be reduced to such a degree that the Emscher could be looked upon as a clean river. Even if all the wastewater in the Emscher area could be treated near the places of origin, the Emscher could not recover to a 'healthy' river due to the bad ratio of 1:4 between original water and used water. It may be possible to get the Emscher water 'clean', rather than just transparent instead of turbid. To reach this optical effect, however, a number of additional treatment plants would have to be erected within the Emscher district. Apart from the high expense of such an undertaking, another problem is even more difficult: to find the numerous places to locate the plants in an area which is already crowed with houses, factories and traffic facilities. (See also W90-01612) (Lantz-PTT)
W90-01692

**ECOLOGICAL AND ECONOMICAL ADVANTAGES OF AN INTEGRATED WATER MANAGEMENT.**
Dortmund Univ. (Germany, F.R.). Inst. for Environmental Protection.
For primary bibliographic entry see Field 5F.
W90-01695

**WATER QUANTITY MANAGEMENT IN URBANISED POLDERS.**
Department of Public Works, Amsterdam (Netherlands). Sewerage and Drainage Dept.
For primary bibliographic entry see Field 5G.
W90-01697

**WETLAND MANAGEMENT IN THE CONTEXT OF REGIONAL PLANNING, EAST CALCUTTA--A CASE STUDY.**
For primary bibliographic entry see Field 5G.
W90-01698

**WATER MANAGEMENT PLANNING IN THE AREA 'CITY OF HANNOVER AND SURROUNDING'.**
Niedersaechsisches Landesamt fuer Wasserwirtschaft, Hildesheim (Germany, F.R.).
For primary bibliographic entry see Field 5G.
W90-01700

**PLAN OF STUDY: CONODOGUINET CREEK AND YELLOW BREECHES CREEK WATERSHEDS, A WATER RESOURCE ASSESSMENT.**
Susquehanna River Basin Commission, Harrisburg, PA.
For primary bibliographic entry see Field 6D.
W90-01706

## 3E. Conservation In Industry

**DESIGN AND CONSTRUCT CONTRACTS IN THE WATER INDUSTRY: 2. THE WAY AHEAD--THE CONTRACTOR'S VIEWPOINT.**
Biwater Ames Crosta, Heywood (England).
For primary bibliographic entry see Field 6B.
W90-01090

## 3F. Conservation In Agriculture

**IN VITRO SELECTION FOR SALINITY AND REGENERATION OF PLANTS IN RICE.**
Osmania Univ., Hyderabad (India). Dept. of Genetics.
For primary bibliographic entry see Field 3C.
W90-01148

**RAINFALL PROBABILITY FORECASTS USED TO MANAGE A SUBDRAINAGE-SUBIRRIGATION SYSTEM FOR WATERTABLE CONTROL.**
Agricultural Univ., Wageningen (Netherlands). Dept. of Hydraulics and Catchment Hydrology.
J. R. Cooper, and J. L. Fouss.
Agricultural Water Management AWMADF, Vol. 15, No. 1, p 47-59, November 1988. 4 fig, 4 tab, 11 ref.

Descriptors: *Surface-groundwater relations, *Water table, *Groundwater management, *Rainfall, *Probabilistic process, *Statistical methods, Precipitation, Irrigation, Root zone, Drainage areas, Water management.

Water management of subsurface-drainage and subirrigation system was simulated using a daily rainfall probability index (RPI), to control the water table depth (WT) in the soil profile. Daily management of 'free drainage,' controlled drainage, or subirrigation, was based upon the RPI value. The RPI was computed from the daily rainfall probability in forecasts issued by the U.S. National Weather Service. Climatic data and weather forecast records (1979-1985) for the lower Mississippi Valley were used in the DRAINMOD program to simulate daily fluctuations in the water table. Various statistical and summation equations were used for computing the RPI. Management success was evaluated by conditions of excess and deficit soil water in the root zone, and by predicted crop yield. Using only the 'today' and 'tonight' segments of the morning (5:25 h) forecast, 75% of the significant rainfall events occurring during the growing season were successfully predicted when the RPI $>$ or $=$ 0.60. Free drainage in advance of predicted storms significantly reduced the duration of excess soil water in the root zone and increased simulated maize yield 0 to 11%, when compared to controlled drainage where the water level at the drain outlet was maintained constant at a level above the drain. (Author's abstract)
W90-01221

**RAINFALL RETENTION PROBABILITIES COMPUTED FOR DIFFERENT CROPPING-TILLAGE SYSTEMS.**
Agricultural Research Service, Tifton, GA. Southeast Watershed Research Center.
W. C. Mills, A. W. Thomas, and G. W. Langdale.
Agricultural Water Management AWMADF, Vol. 15, No. 1, p 61-71, November 1988. 4 fig, 2 tab, 16 ref.

Descriptors: *Rainfall-runoff relationships, *Agricultural watersheds, *Cultivated lands, *Agricultural hydrology, *Probability distribution, *Rainfall impact, Rainfall, Percolation, Soil water.

Rainfall and runoff event data from several different cropping and tillage systems on three field-sized watersheds in the Southern Piedmont of the USA are used to estimate empirical probability distributions of the USDA Soil Conservation Service runoff curve number. Long-term rainfall records from a nearby gauge are also employed to obtain probabilities for rainfall event occurrence and depth. These probability distributions of runoff curve number and rainfall occurrence and depth are incorporated in a recursive computer procedure to compute estimated probability distributions of annual rainfall retention for the different cropping-tillage systems. Comparison of these estimated rainfall retention probability distributions shows a reduction in the risk for low rainfall retention with the installation of conservation tillage systems. (Author's abstract)
W90-01222

**PASTURE EVAPOTRANSPIRATION UNDER VARYING TREE PLANTING DENSITY IN AN AGROFORESTRY EXPERIMENT.**
Griffith Univ., Nathan (Australia). School of Australian Environmental Studies.
J. Eastham, and C. W. Rose.
Agricultural Water Management AWMADF, Vol. 15, No. 1, p 87-105, November 1988. 12 fig, 1 tab, 29 ref.

Descriptors: *Lysimeters, *Evapotranspiration, *Canopy, *Forest hydrology, *Planting management, Vegetation effects, Root zone, Leaves.

Lysimeters were used to measure evapotranspiration (E) from pasture under three planting densities in an agroforestry experiment. Root length densities under pasture at the medium and high tree planting densities were significantly lower than under pasture at the low tree density. During well-watered summer periods, pasture E was found to decrease at closer tree spacing and more compete tree canopy cover. Reductions in leaf area due to either frost damage or drought reduced pasture E. Frost damage to pasture at the closer tree spacing was less severe due to shelter provided by the trees. Relationships between soil water content and the ratio of pasture E to pan evaporation (E sub rho) were obtained at each tree density. During periods when leaf area was not limiting E, E/E sub rho at the same water content was highest from pasture at the low tree density. This trend was attributed to increased shading at high tree densities, reducing radiation and stomatal conductance. (Author's abstract)
W90-01224

**WATER CONTROL AND THE MAINTENANCE IMPERATIVE: EVIDENCE FROM NEPAL.**
Arizona State Univ., Tempe. Div. of Agriculture.
J. C. Baxter, and W. R. Laitos.
Agricultural Water Management AWMADF, Vol. 15, No. 2, p 115-130, December 1988. 3 tab, 20 ref.

Descriptors: *Agricultural hydrology, *Nepal, *Irrigation practices, *Surface water, *Water control, *Irrigation efficiency, *Water distribution, Water management, Water use, Agriculture, Water rights.

Six farmer-managed irrigation systems were examined and compared to three government-managed irrigation systems. Results from these studies indicate that the organizational capacity of farmers' water users' associations to directly manage and maintain the irrigation systems was the most important factor in achieving water control and productive irrigation systems. This factor is referred to as the 'maintenance imperative.; The effective water users' associations demonstrated that they were able to: (1) mobilize significant amounts of labor and money on a continuing basis for maintenance and operation, (2) resolve local conflicts over water, (3) allocate and distribute water equitably, (4) enforce rules, and (5) coordinate cropping patterns and planting dates to optimize the efficient use of available water. The farmer-managed systems displayed a large degree of farmer cooperation and satisfaction, even though most of the systems had substantial operation, maintenance, and cost problems. (Author's abstract)
W90-01225

**ENHANCEMENT OF CROP YIELDS FROM SUBSURFACE DRAINS WITH VARIOUS ENVELOPES.**
Soil and Water Research Inst., Giza (Egypt).
N. l-Mowelhi, A. El-Bershamgy, G. J. Hoffman, and A. C. Chang.
Agricultural Water Management AWMADF, Vol. 15, No. 2, p 131-140, December 1988. 1 fig, 4 tab, 14 ref.

Descriptors: *Crop yield, *Subsurface drains, *Agricultural hydrology, *Drainage systems, *Agriculture, *Irrigation practices, Crop production, Groundwater management, Egypt, Rice, Wheat, Cotton.

A field experiment was conducted for 10 years in the Nile Delta of Egypt to quantify the benefit of subsurface drainage on crop yield. During three crop rotations, subsurface drains at a spacing of 20 m and a depth of 1.5 m doubled the yield of cotton and rice and increased the yield of wheat and clover by 50%. No significant enhancements in crop yield was found from placing various envelope materials around the drains compared to no envelope. Drains of 75 mm diameter resulted in significantly lower yields (20% less) for cotton and rice than drains of 100 mm diameter but there were no yield differences for wheat and clover. Applying 10 Mg/ha of gypsum and deep plowing (25 cm deep) improved yields from 5 to 19% for all crops, cotton and clover having the largest yield improvement. Soil salinity to a depth of 1.5 m was reduced from an average 5.3-2.2 dS/m after 1 year of drainage without additional water being applied beyond the normal irrigation amounts and rainfall. (Author's abstract)
W90-01226

**ESTIMATING THE VALUE OF FLOOD ALLEVIATION ON AGRICULTURAL GRASSLAND.**
Silsoe Coll. (England).
T. M. Hess, and J. Morris.
Agricultural Water Management AWMADF, Vol. 15, No. 2, p 141-153, December 1988. 2 fig, 7 tab, 11 ref.

Descriptors: *Flood forecasting, *Flood damage, *Agricultural hydrology, *Flood control, *Flood protection, *Flood frequency, *Cost analysis, *Agricultural runoff, Agricultural watersheds, Surface water, Mathematical studies, Rainfall-runoff relationships, Drainage areas.

The assessment of flood damage costs on farmland is a necessary part of the evaluation of land drainage improvement schemes and maintenance programs. A method is presented for calculating the average annual cost of flooding and the extra benefits or costs associated with given changes in flooding regime. Particular reference is made to the effect of land use, flood frequency and seasonality on flood costs. The seasonally weighted flood loss is calculated from a mathematical expression that accounts for the loss from a particular month and the probability of the flood occurring in that month. The method is illustrated by means of a simplified case study that examines the agricultural benefits of reduced summer flooding in an area of environmental importance. In the example, the derived flood/flow area curve is combined with the damage/frequency curve to give the flood damage/area relationship and a resultant average annual flood loss for a specific area of land. The scheme, in this case, proposed to alleviate all summer floods up to a design flow; flows in excess of this level will not be affected and will still flood the same area as without the scheme. (Author's abstract)
W90-01227

**IRRIGATION SCHEDULING UNDER A LIMITED WATER SUPPLY.**
Indian Agricultural Research Inst., New Delhi. Water Technology Center.
N. H. Rao, P. B. S. Sarma, and S. Chander.
Agricultural Water Management AWMADF, Vol. 15, No. 2, p 165-175, December 1988. 3 tab, 17 ref, append.

Descriptors: *Irrigation practices, *Irrigation programs, *Water supply, *Crop yield, *Agricultural hydrology, *Water allocation, Agriculture, Irrigation, Mathematical studies, Soil water, Water stress, Crop production.

The problem of scheduling irrigation at weekly intervals for a single crop when water supply is limited is considered. The mathematical formulation is based on a dated-water-production function, weekly soil-water balance, and a heuristic assumption that water stress in the early weeks of a crop-growth stage leads to suboptimal yields. The allocation problem is solved at two levels, growth stages, and weeks. At the first level, the dated water-production function is maximized by dynamic programming to obtain optimal allocations for growth stages. At the second, the water allocated to each growth stage is re-allocated to satisfy weekly water deficits within the stage in a sequential order, beginning with the first week of the stage. Water delivery and soil-water storage constraints are included at both levels. The model is applied to a field problem to derive weekly irrigation programs for cotton under various levels of seasonal water supply and initial soil moisture. (Author's abstract)
W90-01228

**IRRIGATION SCHEDULING AND CANTALOUPE YIELD MODEL FOR THE JORDAN VALLEY.**
Jordan Univ., Amman. Dept. of Soils and Irrigation.
A. M. Battikhi, and R. W. Hill.
Agricultural Water Management AWMADF, Vol. 15, No. 2, p 177-187, December 1988. 3 fig, 1 tab, 11 ref.

Descriptors: *Irrigation practices, *Irrigation programs, *Crop yield, *Agricultural hydrology, *Hydrologic models, Jordan River Valley, Soil water, Water management, Model studies, Agricultural watersheds, Irrigation.

A crop yield and soil water management simulation model (CRPSM) developed at Utah State University was modified and calibrated using data from a trickle irrigation experiment with different mulched treatments on cantaloupe (Cucumis melo L.) in the Jordan Valley. The soil water budget model was adapted to the field conditions through input describing rooting depth, field capacity, wilting point and wet soil surface air-drying characteristics. Observed field crop growth progress was used for the model's phenology clock. Calibration of the yield model was accomplished by adjusting model parameters to obtain a reasonable match between model and field yields. Simulated possible irrigation schedules were tested using different options provided by the model. By using 1.5 cm per irrigation for a total of 44 to 47 irrigations and starting the first instead of the last of April, simulated yields were about double what was actually obtained in the field. This indicates that the date of first irrigation as well as total water applied is important for maximizing yield. Plants in the field were apparently subjected to water stress prior to late April when irrigation was initiated. The use of the CRPSM model could reduce the number of plots needed in further field experimentation since the less successful possibilities could be identified by simulation. Thus, field efforts can be concentrated on treatments most likely to provide higher

yields with improved irrigation management. (Author's abstract)
W90-01229

**AQUEDUCT AND RESERVOIR CAPACITIES FOR DISTRIBUTION SYSTEMS.**
Hampton Univ., VA.
For primary bibliographic entry see Field 5F.
W90-01343

**WATER RESOURCES MANAGEMENT IN NORTH CHINA PLAIN.**
Humboldt State Univ., Arcata, CA. Dept. of Environmental Resources Engineering.
For primary bibliographic entry see Field 6A.
W90-01346

**DEVELOPMENT OF A MODEL FOR PRODUCTION OF WATER TRANSFER IN A SEMI-ARID ZONE IN TUNISIA (ELABORATION D'UN MODELE DE PREDICTION DU TRANSFERT HYDRIQUE SOUS JACHERE DANS LES ZONES SEMI-ARIDES DE LA TUNISIE).**
Institut National Agronomique de Tunis (Tunisia). Centre de Gestion des Ressources en Eau.
H. Daghari, C. Laroussi, M. Maalej, and L. W. deBacker.
IN: Computer Methods and Water Resources: First International Conference, Morocco, 1988. Vol. 3, Computational Hydrology. Computational Mechanics Publications, Boston. 1988. p 63-74, 2 fig, 8 ref. English summary.

Descriptors: *Irrigation design, *Soil water, *Agricultural hydrology, *Tunisia, *Semiarid lands, *Model studies, Vegetation effects, Mathematical models, Rainfall infiltration, Farming.

A mathematical model was developed to estimate the available soil water under bare soil conditions or with a small cover of vegetation. The region of Medjez El Bab in Northwest Tunis is in a semiarid zone characterized by irregular rainfall. Irrigation is used to permit cultivation of cereals. The model was based on conditions in this area derived from two parcels of land, one maintained without vegetation and the other with a natural vegetative cover from December to May. Hydraulic profiles measured in the field and predicted by the model were compared. The model proved satisfactory for this purpose; it could also be used to simulate soil moisture changed in soil during and after a rainfall. (See also W90-01409) (Peters-PTT)
W90-01415

**COMPUTER MODEL FOR PREDICTING RUNOFF FROM A BENCH TERRACED FIELD.**
Central Soil and Water Conservation Research and Training Inst., Dehra Dun (India).
For primary bibliographic entry see Field 4A.
W90-01419

**PRELIMINARY ASSESSMENT OF SOIL HYDRAULIC PROPERTIES, AND THEIR IMPLICATIONS FOR AGRO FORESTRY MANAGEMENT IN GRENADA, WEST INDIES.**
Plymouth Polytechnic (England). Dept. of Geographical Sciences.
For primary bibliographic entry see Field 2G.
W90-01470

**HYDROLOGY OF AN ACID WETLAND BEFORE AND AFTER DRAINING FOR AFFORESTATION, WESTERN NEW ZEALAND.**
New Zealand Forest Service, Rotorua. Forest Research Inst.
For primary bibliographic entry see Field 4C.
W90-01474

**DISSOLVED ORGANIC COMPONENTS IN PROCESS WATER AT THE LOS BANOS DESALTING FACILITY.**
California Univ., Los Angeles. School of Engineering and Applied Science.
For primary bibliographic entry see Field 5D.
W90-01534

**EVALUATION OF THE HYDROLOGICAL RESPONSE OF A DRAINAGE NETWORK.**
Ecole Polytechnique Federale de Lausanne (Switzerland). Inst. for Agricultural Engineering.
For primary bibliographic entry see Field 2A.
W90-01596

**URBAN WATER SUPPLY IN ARID ENVIRONMENT-EXAMPLES FROM THE ARABIAN PENINSULA.**
Dornier-System G.m.b.H., Friedrichshafen (Germany, F.R.). Dept. for Regional and Environmental Planning.
For primary bibliographic entry see Field 5F.
W90-01629

**IRRIGATION AND WATER ALLOCATION.**
Proceedings of an International Symposium held during the XIXth General Assembly of the International Union of Geodesy and Geophysics at Vancouver, British Columbia, Canada, 9-22 August 1987. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. 1987. IAHS Publication No. 169. Edited by T.H. Anstey and U. Shamir. 245p.

Descriptors: *Irrigation efficiency, *Irrigation practices, *Water allocation, *Soil water, *Project planning, Model studies, Groundwater recharge, Irrigation effects, Irrigation requirements, Irrigation engineering, Irrigation water, Irrigation, Crop production, Arid lands.

Two main topics were discussed during the International Symposium of the XIXth General Assembly of the International Union of Geodesy and Geophysics: interaction of irrigation and hydrological processes; and irrigation water allocation within a system. Eleven papers were accepted for the first topic of the symposium. These papers discuss the following sub-topics: long-term planning for demands of irrigation water; soil-water regime in a maize canopy for modelling an irrigation and drainage system; supplementation of irrigation canal water by storm water inflow; interactions within irrigation hydrologic cycles; groundwater hydrology and irrigation processes; over-irrigation of paddy fields for artificial groundwater recharge; and, irrigation effects on the chemical balance in the water and soil environment. Ten papers selected for the second main theme of the symposium discuss the following sub-topics: simulations to rehabilitate small irrigation schemes; rice irrigation during water shortages; irrigation scheduling and climate in India; predicting water demands for irrigation; factors affecting crop coefficient when calculating crop evapotranspiration; simulating water requirements for cereal crops and forecasting irrigation demands in China; optimal use of irrigation water in Garufella Catchment, India; design of water allocation and water distribution networks by graph-theory; necessary volume of groundwater reservoirs for optimal conjunctive water use of arid region irrigation; and integrated irrigation system optimization analysis. (See W90-01829 thru W90-001849) (Geiger-PTT)
W90-01828

**IRRIGATION SYSTEMS MANAGEMENT RELATED TO METEOROLOGICAL FACTORS AND WATER RESOURCES.**
Ceske Vysoke Uceni Technicke v Praze. Faculty of Civil Engineering.
M. Holy, and Z. Kos.
IN: Irrigation and Water Allocation. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication no. 169, 1987. p 5-14. 3 tab, 18 ref.

Descriptors: *Irrigation efficiency, *Stochastic models, *Irrigation requirements, *Water demand, *Czechoslovakia, Meteorological data collection, Precipitation, Air temperature, Humidity, Wind velocity, Evapotranspiration.

Irrigation water requirements form a stochastic component of water demand and consumption in water resource systems. Their long-term planning should be based on methods and models reflecting the stochastic character of irrigation water demands. Methods of assessing irrigation water demands in semihumid zones are described. Models for calculating mean monthly time series of irrigation water demands based on precipitation, temperature, and humidity, supplemented by wind velocity and sunshine data, are given. Irrigation systems in the River Labe basin in Czechoslovakia were used as a test case and illustrate the application of the proposed model. (See also W90-01828) (Author's abstract)
W90-01829

**IMPACT OF UNCONTROLLED URBAN STORM-WATER INFLOW ON THE OPERATION OF IRRIGATION MAIN CANAL SYSTEMS.**
Calgary Univ. (Alberta). Dept. of Civil Engineering.
For primary bibliographic entry see Field 4C.
W90-01830

**DETERMINATION OF FUNDAMENTAL DESIGN PARAMETERS OF IRRIGATION AND DRAINAGE SYSTEMS BY MEANS OF MATHEMATICAL MODELLING OF SOIL-WATER REGIME.**
Slovenska Akademia Vied, Bratislava (Czechoslovakia). Ustav Hydrologie a Hydrauliky.
J. Benetin, and A. Soltesz.
IN: Irrigation and Water Allocation. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication no. 169, 1987. p 27-37. 5 fig, 1 tab, 3 ref.

Descriptors: *Irrigation requirements, *Irrigation design, *Mathematical models, *Soil water, *Irrigation canals, Precipitation, Infiltration, Evapotranspiration, Surface runoff, Capillarity, Simulation analysis.

Until efficient computer were available, hydrological design parameters of irrigation and drainage systems for the total irrigation requirement (cu m/ha) and total drainage discharge (cu m/ha) were calculated from the soil-water balance in a year of average precipitation and applied in dry or wet years. In many countries, rough procedures for selecting parameters for dry or wet years were usually based on the experience of irrigation or drainage systems already operating. Mathematical modelling enables retrospective simulation of soil-water balance when data from a sufficiently long series of years are available. At the same time irrigation or drainage system functions may be included. In this way the time and quantity of required irrigation and drainage water may be calculated. The mathematical model was applied to balance the soil-water regime in a maize canopy on a loamy soil in the Zitava River basin of the CSSR. The empirical cumulative frequency curve of the water deficit in soil, constructed from the model for a whole vegetation period is practically the cumulative frequency curve of the total irrigation requirement. Its advantage is that it corresponds to the actual weather course in the calculated year series. By connecting the cumulative frequency curve with an equation which expresses the percentage of yield increase of irrigated crops relative to the amount of their total water requirement the total design requirements of the irrigation system were determined. (See also W90-01828) (Geiger-PTT)
W90-01831

**HYDROLOGY OF IRRIGATION AND THE IMPACT OF IRRIGATION ON THE HYDROLOGIC CYCLE.**
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
H. J. Morel-Seytoux, A. S. Turbak, and M. J. Abdulrazzak.
IN: Irrigation and Water Allocation. International Association of Hydrological Sciences Press, Insti-

tute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication no. 169, 1987. p 39-48. 3 fig, 9 ref.

Descriptors: *Mathematical models, *Irrigation efficiency, *Infiltration rate, *Hydrologic cycle, *Irrigation effects, Irrigation design, *Groundwater movement, Groundwater recharge, Computer models.

Explicit relatively simple expressions were derived from basic physical principles of infiltration to relate quantities of interest in irrigation (such as degree of infiltration uniformity) to surface and subsurface characteristics. Such explicit relations are useful in planning and design stages for irrigation, a managed modification of the hydrologic cycle. Irrigation effects on aquifer recharge and groundwater flow were examined. A technique was devised to obtain explicitly and simply the reflected and transmitted fractions of excess irrigation for both constant and variable infiltration rates. Results of computer simulations for the variable infiltration rate compared well with field data. The laterally transmitted fraction sets the groundwater in motion with ultimate discharge to a canal or river. In many arid regions such aquifer recharge sustains a perennial flow in rivers that would have been ephemeral in character. Because of its impact on the hydrologic cycle, irrigation on a large scale will transform it from a natural mode to a managed one. (See also W90-01828) (Geiger-PTT)
W90-01832

**STUDIES ON SUBSURFACE WATER POTENTIAL AND QUALITY FOR IRRIGATION.**
Karnataka Regional Engineering Coll., Suratkal (India).
For primary bibliographic entry see Field 4B.
W90-01833

**NUMERICAL ANALYSIS OF WATER AND SOLUTE MOVEMENT IN REALISTICALLY COMPLEX SOIL PROFILES.**
Commonwealth Scientific and Industrial Research Organization, Wembley (Australia). Div. of Groundwater Research.
For primary bibliographic entry see Field 2G.
W90-01834

**EFFECT OF IRRIGATION METHODS ON GROUNDWATER LEVELS IN GLACIATED TERRAIN.**
Agriculture Canada, Lethbridge (Alberta). Research Station.
G. J. Beke, and T. Entz.
IN: Irrigation and Water Allocation. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication no. 169, 1987. p 91-98. 3 fig, 3 tab, 5 ref.

Descriptors: *Irrigation effects, *Groundwater level, *Flooding, *Sprinkler irrigation, Water table fluctuations, Canada, Groundwater recharge, Water table rise, Water table decline, Soil water.

Water tables were continuously monitored at eight sites in southern Alberta for a period ranging from 14 to 28 years to determine the effect of irrigation management on groundwater levels. Water tables receded during the winter months to depths below 175 cm, with the lowest levels occurring in soils with till at depths greater than 150 cm. Highest water tables were generally encountered in the spring, and were caused by natural recharge. The level flooding method generally caused higher summer water tables than the sprinkling methods. Center-pivot sprinkling occurred at only one of the sites, where it caused lower water tables than either side-roll or hand-move sprinkling. Modifications to district infrastructure and to irrigation systems affected the water tables to varying extents and interfered with the evaluation of methods, particularly the sprinkling methods. (See also W90-01828) (Author's abstract)
W90-01837

**OVER-IRRIGATION OF PADDY FIELDS FOR THE PURPOSE OF ARTIFICIALLY RECHARGING GROUNDWATER IN THE CONJUNCTIVE USE SCHEME OF THE CHO-SHUI RIVER BASIN.**
National Taiwan Univ., Taipei. Dept. of Agricultural Engineering.
Y. S. Tsao.
IN: Irrigation and Water Allocation. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication no. 169, 1987. p 99-109. 4 fig.

Descriptors: *Irrigation effects, *Groundwater recharge, *Artificial recharge, *Groundwater management, *Mathematical models, *Conjunctive use, Hydrologic cycle, Water supply, Water demand, Model studies.

For centuries, paddy fields have played a significant role in the hydrological cycle of eastern Asia, especially groundwater recharge. To amplify the function of paddy fields in this respect, a plot of 195 ha in the upstream portion of the Cho-Shui River was over-irrigated for three years in order to replenish groundwater and to reduce the serious ill effects caused by over-pumping. From the results obtained in this experiment, over-irrigation of paddy fields was deemed the most efficient and economical method of artificially recharging groundwater especially in the Cho-Shui River basin. The over-irrigation of paddy fields will be the most important part of a planned conjunctive use scheme (Chi-Chi Conjunctive Use Scheme). A mathematical model is presented to compare the effects on perennial yields among the different schemes of over-irrigation. Mathematical models predicted that with a volume of artificial recharge of 86.8 million tons per year by over-irrigation in the paddy fields, the groundwater level at sea level would be prevented from moving inland. It is proposed that the water obtained from the Chi-Chi Weir, in addition to the 240 million tons for over-irrigation, be apportioned as follows: 41 million tons to public water uses, 345 million tons to aquaculture fish ponds, and the rest to irrigate paddy fields other than those located in the natural groundwater recharge zone. (See also W90-01828) (Geiger-PTT)
W90-01838

**EFFECTS OF IRRIGATION ON THE CHEMICAL BALANCE IN THE ECOLOGICAL ENVIRONMENT OF WATER AND SOIL.**
Changchun Coll. of Geology (China). Station of Environmental Hydrogeology.
C. X. Gui.
IN: Irrigation and Water Allocation. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication no. 169, 1987. p 111-124. 3 fig, 12 tab.

Descriptors: *Water chemistry, *Irrigation effects, *China, *Soil water, *Soil properties, *Salinity, *Soil chemistry, Mineralization, Capillarity, Chemical properties, Irrigation programs, Groundwater pollution.

Irrigation has caused the chemical balance of the Songnen Plain water-soil ecotope to change. The change must be made beneficial by channelling irrigation water from the Songhaujiang River to improve the ecotope of farmland. Because irrigation water joins the ion cycle in the water-soil ecotope, the original water-soil chemical balance is disturbed causing some ecological problems, such as secondary soil salinization and pollution of groundwater. A scientific approach to irrigation is the key to improving the water-soil ecotope in the irrigation area. This would involve establishment of an improved irrigation system by making the design such that irrigation would be timely, drainage adequate, and desalinization stimulated. The area of paddy fields should be expanded, and evaporation reduced to accelerate the process of washing salt. The surface and groundwater should be utilized in a comprehensive way by making full use of the groundwater resources for irrigation and reducing its level to prevent the occurrence of secondary salinization. (See also W90-01828) (Geiger-PTT)
W90-01839

**SIMULATION MODEL TO DETERMINE BENEFITS FROM IMPROVED CROP AND WATER MANAGEMENT WITH REHABILITATION OF SMALL IRRIGATION SCHEMES.**
Klohn Leonoff Ltd., Richmond (British Columbia).
C. D. Sellars, and D. E. Schroeter.
IN: Irrigation and Water Allocation. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication no. 169, 1987. p 129-139. 1 fig, 2 tab, 7 ref.

Descriptors: *Irrigation efficiency, *Irrigation rehabilitation, *Irrigation engineering, *Sri Lanka, *Crop production, *Water management, *Model studies, Irrigation programs, Simulation analysis, Crop yield.

Rehabilitation of small irrigation schemes generally includes reconstruction of the headworks and distribution system, and measures to improve crop and water management. To assess the benefits from rehabilitation, the anticipated increases in agricultural production have to be determined. Small irrigation schemes typically have a highly variable water supply and limited reservoir storage. Consequently, irrigated areas and crop yields are highly variable and a simulation model (the WATMAN computer model) was developed to allow for this variability. The application of the simulation model to assess benefits from rehabilitation of a small irrigation scheme in Sri Lanka is illustrated. The proposed crop and water management improvements were simulated in the model, and it was found that most of the increases in the harvested area could be accounted for by improvements in water supply distribution and use resulting from changes in crop management. Changing the cropping patterns had a greater effect on agricultural production than improved water management. (See also W90-01828) (Author's abstract)
W90-01840

**TACTICAL OPERATION OF RICE IRRIGATION SYSTEMS DURING WATER SHORTAGES.**
Birmingham Univ. (England). Dept. of Civil Engineering.
D. H. Rees.
IN: Irrigation and Water Allocation. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication no. 169, 1987. p 141-152. 3 fig, 3 tab, 8 ref.

Descriptors: *Drought, *Model studies, *Irrigation efficiency, *Irrigation practices, *Crop production, *Computer models, Irrigation requirements, Irrigation programs, Drought, Crop yield, Sri Lanka, Rice, Model studies, Evapotranspiration.

Various tactics are examined for use on tropical, small-holder rice irrigation schemes during drought periods using the Kaudulla irrigation system of Sri Lanka. The interaction of the rice crop with its environment was simulated using the RICEMOD model, modified to fit the Sri Lanka situation. From results of the simulation analysis it was concluded that substantial water savings may be obtained without significantly impairing crop yield. If yield losses are unavoidable, those losses can be minimized by adoption of a combination of tactics. Knowledge of farm level and distribution system conditions is needed in determining which tactics would be most appropriate to minimize losses in crop yield. The use of environmental variables such as field irrigation requirement, depth of standing water layer, operating depth, actual crop evapotranspiration, seepage and percolation loss, and effective rainfall can provide important information for system management, as long as the model used is fully verified in the field. (See also W90-01828) (Geiger-PTT)
W90-01841

**SCHEDULING IRRIGATION BASED ON SOME CLIMATIC INDICES FOR CROPS IN MAHARASHTRA OF WESTERN PENINSULAR INDIA.**
Andhra Univ., Waltair (India). Dept. of Meteorology and Oceanography.
A. R. Subramaniam, and A. S. Rao.
IN: Irrigation and Water Allocation. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication no. 169, 1987. p 153-162. 4 fig, 2 tab, 12 ref.

Descriptors: *Irrigation scheduling, *Irrigation efficiency, *India, *Drought, Evapotranspiration, Soil water, Soil water potential, Rainfall, Crop production, Irrigation requirements.

Maharashtra experiences a spectrum of climates ranging from perhumid to semi-arid. The agriculture is highly influenced by the vagaries of monsoon rainfall in the region. The black soils (Vertisols) predominate practically all over Maharashtra. The region plays a leading role in India, in the production of sorghum, millets, rice, wheat, cotton and sugarcane. For irrigation planning, the probabilities of the moisture adequacy index (ratio of actual/potential evapotranspiration) in different cropping seasons covering various climatic conditions have been computed. The actual evapotranspiration was derived from soil water budgeting using the data of potential evapotranspiration, rainfall and storage capacity of the soils. The crop evaporation values were obtained either from lysimetric data or from empirical estimates. The ratios of measured evapotranspiration to the cumulative potential evapotranspiration for various crops were compared with the probabilities of moisture adequacy indices at different locations for evaluation of irrigation requirements. The grain yields of crops in different years are also compared with the drought severity indices of Palmer to obtain the validity of such indices for evaluation of moisture status and agricultural drought conditions. (See also W90-01828) (Author's abstract)
W90-01842

**PREDICTING WATER DEMANDS FOR IRRIGATION.**
Akademiya Nauk SSSR, Moscow. Inst. Vodnykh Problem.
For primary bibliographic entry see Field 6D.
W90-01843

**FACTORS AFFECTING CROP COEFFICIENT WHEN CALCULATING CROP EVAPOTRANSPIRATION.**
Water Research Centre, Cairo (Egypt).
M. Semaika, and A. H. Rady.
IN: Irrigation and Water Allocation. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication no. 169, 1987. p 175-184. 3 fig, 8 tab, 11 ref.

Descriptors: *Evapotranspiration, *Irrigation requirements, *Soil moisture retention, *Water use efficiency, Alluvial soils, Irrigation efficiency, Crop production, Calcareous soils.

Actual evapotranspiration of sugar beet was measured by the soil moisture depletion method using lysimeters to compare irrigation of calcareous and alluvial soils under different levels of available soil moisture depletion (ASMD): 20%, 40%, 60%, and 80%. Evapotranspiration rates in calcareous soil were less than those of alluvial soil. Their values decreased as ASMD increased. The significantly highest values, number of leaves, plant height, fresh and dry weights, length and diameter of roots were obtained when plants were subjected to 40% ASMD in both soils, but higher for alluvial soil. The yields of roots and sucrose of plants grown in calcareous soil were less than those of the alluvial soil. However, water use efficiency of the calcareous soil was higher than that of the alluvial soil. Crop coefficient values using the modified Penmann method for estimating potential evapotranspiration proved that they mainly depend on ASMD level at the root zone and soil texture besides the crop characteristics. The magnitudes of these values were higher in alluvial soil than in calcareous soil. Moreover, the highest value was obtained at 20% ASMD for alluvial soil. (See also W90-01828) (Author's abstract)
W90-01844

**SIMULATION OF WATER REQUIREMENTS FOR MAJOR CEREAL CROPS AND FORECASTING LONG-RANGE IRRIGATION DEMANDS IN CHINA.**
Zhongshan Univ., Guangzhou (China).
J. Hanyang.
IN: Irrigation and Water Allocation. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication no. 169, 1987. p 185-194. 1 fig, 1 tab, 17 ref.

Descriptors: *China, *Irrigation requirements, *Model studies, *Irrigation efficiency, Crop production, Crop yield, Rice, Wheat, Corn, Economic aspects, Climates.

Agricultural water used for irrigation is vital to China because irrigation is one of the most effective measures to increase that country's food crop yields. A model called WATER, with climate data sets of 241 stations, was used to simulate crop water requirements for irrigated rice, wheat, and maize. It is necessary to analyze the economic benefit of water used in irrigation. Therefore another model, called YIELD, was employed to simulate the potential yield under full irrigation conditions. The simulations gave the results of the total annual water used for irrigating rice, wheat, and maize to be 540 billion-580 billion cu m and the corresponding cereal crop yields to be 475 billion kilograms. (See also W90-01828) (Author's abstract)
W90-01845

**OPTIMAL UTILIZATION OF IRRIGATION WATER IN GARUFELLA CATCHMENT IN ASSAM, INDIA.**
Roorkee Univ. (India). School of Hydrology.
R. Singh, B. Soni, and A. K. Changkakoti.
IN: Irrigation and Water Allocation. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication no. 169, 1987. p 195-205. 4 tab, 4 ref.

Descriptors: *India, *Irrigation efficiency, *Irrigation requirements, Monsoons, Rainfall, Hydrologic models, Water use efficiency, Climates, Crop production, Topography, Soil properties, Crop yield, Model studies.

In India, only about one fourth of the cultivated land is irrigated and agriculture on the remaining three fourths largely depends on vagaries of the monsoon. In the Garufella catchment, which is situated in Assam, India, about 90% of the rainfall occurs during the monsoon. In the Garufella Catchment, which is situated in Assam, India, about 90% of the rainfall occurs during the monsoon period from June to October. In winter and summer the area is mainly irrigated by surface water available from the Garufella River. There has been no planned irrigation development in the catchment, which has a culturable area of 8420 ha. Linear and Goal programming models for optimal utilization of irrigation water for the winter season were developed considering such factors as soil characteristics, topography, climatic pattern, cropping intensity, crop water requirement, water resources, and socio-economic conditions. The water and land utilization, net return and total production from the agricultural crops under various plans were worked out. The optimal goal programming plan called for the highest acreage going to wheat followed by pulses, oilseeds, early ahu paddy, and then potato crops for the highest level of satisfaction of the protein, calorie and food requirements of the society. (See also W90-01828) (Author's abstract)
W90-01846

**HIERARCHICAL METHOD FOR THE DESIGN OF WATER ALLOCATION AND WATER DISTRIBUTION NETWORKS BASED ON GRAPH-THEORY.**
Tel-Aviv Univ. (Israel). Faculty of Engineering.
Y. Rubin.
IN: Irrigation and Water Allocation. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication no. 169, 1987. p 207-220. 5 fig, 1 tab, 15 ref, append.

Descriptors: *Water allocation, *Water distribution, *Model studies, Water demand, Irrigation requirements, Graphical methods, Algorithms, Mathematical models.

A heuristic procedure for defining optimal water resources allocation is presented, which can be extended for the design of least cost water distribution networks. The design process is presented as a two-stage hierarchical process: (1) an image-setting stage and (2) a detailed design stage. The first stage deals with the allocation of the water resources among potential users according to certain demand constraints and economic considerations. The design at this stage is rather schematic, and is carried out on a trial-and-error basis. The second stage serves to update the cost figures by considering the physical aspects of the network required for the trans-shipment of the allocated resources. The two stages are carried out iteratively, although they can be performed independently. The method employs as its basic tool the Out-Of-Kilter algorithm, known from graph-theory. The method is described in detail, and is compared with a linear programming based method, showing favorable results. (See also W90-01828) (Author's abstract)
W90-01847

**DETERMINATION OF THE NECESSARY VOLUME OF THE GROUNDWATER RESERVOIRS FOR OPTIMAL CONJUNCTIVE WATER USE FOR IRRIGATION IN AN ARID REGION.**
Hanover Univ. (Germany, F.R.). Inst. fuer Grundbau, Bodenmechanik und Energiewasserbau.
For primary bibliographic entry see Field 4B.
W90-01848

**EXPERIENCES WITH INTEGRATED IRRIGATION SYSTEM OPTIMIZATION ANALYSIS.**
Toronto Univ. (Ontario). Dept. of Civil Engineering.
K. Ponnambalam, and B. J. Adams.
IN: Irrigation and Water Allocation. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication no. 169, 1987. p 229-245. 2 fig, 3 tab, 10 ref, append.

Descriptors: *Model studies, *Optimization, *Irrigation requirements, *Irrigation efficiency, *India, *Water allocation, *Stochastic models, Irrigation water, Model studies, Reservoirs, Algorithms, Optimization, Simulation analysis.

The optimal irrigation water allocation was determined for the Parambikulam-Aliyar Project (PAP) to maximize the net benefits of agricultural production subject to the physical and institutional constraints of this canal-farm system. Aggregation/decomposition models were developed and stochastic dynamic programming (SDP) optimization was performed for the reservoir level to provide a closed-loop type of policy. A modified SDP model was proposed for the farm level optimization. A deterministic coordination between the reservoir and farm level is accomplished by a Dantzig-Wolfe type linear programming algorithm. Experiments conducted on the SDP solution methods identified the appropriate solution method depending upon the type and size of the problem. Simulation was used to compare the performance of the derived optimal policy with the past performance of the PAP. The performance of the proposed models was very satisfactory. (See also W90-01828) (Geiger-PTT)
W90-01849

**MODELLING THE EFFECTS OF AGROTECHNICAL MEASURES ON SPRING RUNOFF AND WATER EROSION.**
Akademiya Nauk SSSR, Moscow. Inst. Vodnykh Problem.
For primary bibliographic entry see Field 2C.
W90-01871

# 4. WATER QUANTITY MANAGEMENT AND CONTROL

## 4A. Control Of Water On The Surface

**DESIGN OF A DIVERSION SYSTEM TO MANAGE THE FIRST FLUSH.**
Virginia Polytechnic Inst., Blacksburg. Dept. of Civil Engineering.
C. Y. Kuo, and J.-L. Zhu.
Water Resources Bulletin WARBAQ, Vol. 25, No. 3, p 517-525, June 1989. 6 fig, 1 tab, 8 ref.

Descriptors: *Urban hydrology, *Storm drains, *Storm sewers, *Storm runoff, *Diversion structures, *Model studies, *Urban runoff, Systems analysis.

To manage the first flush of storm runoff in urbanized areas, a diversion box and detention basin system has been proposed for a new storm sewer system or for retrofitting an existing system. A software package for a personal computer has been developed to facilitate the analysis and design of the system. Hydrographs and pollutographs are generated at the inlet and outlet of the diversion box and the detention basin. The peak outflow and peak pollutant concentration are compared with the allowable outflow and pollutant concentration for urban stormwater quantity and quality management. The model is developed for both analysis and design purposes. (Author's abstract)
W90-00965

**EXPERIMENTAL ANALYSIS OF RESERVOIR RELEASE WAVE ROUTING IN UPLAND BOULDER BED RIVERS.**
Birmingham Univ. (England). School of Earth Sciences.
For primary bibliographic entry see Field 2E.
W90-01076

**RIVER BASIN MANAGEMENT AND PRIVATIZATION.**
D. Kinnersley.
Journal of the Institution of Water and Environmental Management, Vol. 3, No. 3, p 219-226, June 1989.

Descriptors: *Watershed management, *Stream fisheries, *Privatization, *Water resources development, *River basins, *Water management, *Environmental policy, *Flood protection, Political aspects, Public participation, Utilities, Management planning, River regulations, Selective withdrawal, Effluents, Community development, Water quality standards, Inland waterways, Tidewater.

Two upheavals in the U.K. during the past fifty years can be defined. One is the privatizing of the water-utility services of the ten regional authorities; the other is wholly concerned with environmental functions, that is river management tasks such as flood protection and fisheries, and in the regulation of water abstractions and of effluent discharges making use of inland and tidal waters. It can be concluded that privatization of the water utilities must be more than another structural change which fails to be followed through in policies and new attitudes, more than just another cycle of legislation, reshaping and disappointment. This is dependent on what every company and every person involved is prepared to contribute themselves. (Fish-PTT)
W90-01087

**PRACTICAL COMPARISON OF FLOOD FORECAST METHODS. EXAMPLE OF THE AVEYRON RIVER (COMPARAISON PRATIQUE DE METHODES DE PREVISION DE CRUE. EXEMPLE DE L'AVEYRON).**
Centre National de la Recherche Scientifique, Toulouse (France). Inst. de Mecanique des Fluides.
For primary bibliographic entry see Field 7C.
W90-01131

**REAL TIME DECISION PROCEDURES RELATING TO FLOOD FORECASTING (LES PROCEDURES DE DECISION EN TEMPS REEL POUR LA PREVISION DES CRUES).**
Centre d'Enseignement et de Recherche pour la Gestion des Ressources Naturelles et l'Environnement, Paris (France).
For primary bibliographic entry see Field 7C.
W90-01132

**PROPAGATION OF FLOODS WITH THE CONSTRAINED LINEAR SYSTEM (CLS). REAL TIME APPLICATION IN THE FORECAST INFORMATION SYSTEM (PROPAGATION DES CRUES AVEC LE CONSTRAINED LINEAR SYSTEM (CLS): APPLICATION EN TEMPS REEL DANS LE SYSTEME INFORMATIQUE DE PREVISION).**
LHF, 6, Rue de Lorraine, 38130 Echirolies, France.
For primary bibliographic entry see Field 7C.
W90-01137

**WATER CONTROL AND THE MAINTENANCE IMPERATIVE: EVIDENCE FROM NEPAL.**
Arizona State Univ., Tempe. Div. of Agriculture.
For primary bibliographic entry see Field 3F.
W90-01225

**ESTIMATING THE VALUE OF FLOOD ALLEVIATION ON AGRICULTURAL GRASSLAND.**
Silsoe Coll. (England).
For primary bibliographic entry see Field 3F.
W90-01227

**CLUSTER ANALYSIS AS APPLIED TO REGIONAL FLOOD FREQUENCY.**
Manitoba Univ., Winnipeg. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W90-01344

**COMPARISON OF EFFECTIVE RAINFALL SEPARATION TECHNIQUES APPLIED TO THE DERIVATION OF CATCHMENT AVERAGE UNIT HYDROGRAPHS.**
Queen Mary Coll., London (England).
For primary bibliographic entry see Field 7B.
W90-01417

**COMPUTER MODEL FOR PREDICTING RUNOFF FROM A BENCH TERRACED FIELD.**
Central Soil and Water Conservation Research and Training Inst., Dehra Dun (India).
V. V. D. Narayana, and G. Sastry.
IN: Computer Methods and Water Resources: First International Conference, Morocco, 1988. Vol. 3, Computational Hydrology. Computational Mechanics Publications, Boston. 1988. p 105-116, 7 fig, 5 ref.

Descriptors: *Model studies, *Computer models, *Rainfall-runoff relationships, *Runoff forecasting, *Terracing, *Hydrologic models, Hydrologic properties, Runoff, Rainfall intensity, Mathematical equations, Hydrographs, Statistical analysis.

Bench terracing has been practiced in India for quite some time. Runoff disposal is an essential component for successful performance of bench terraces. A computer model based on continuity and momentum equations has been developed and programmed IBM 370/145 System. Influence of various parameter, including rainfall intensity, land slope and detention storage have been isolated. The model has been tested from the data collected from experimental bench terraced fields. Statistical analysis of 18 pairs of observed and computed hydrographs show that the difference is not significant at the 5% level. (See also W90-01409) (Author's abstract)
W90-01419

**METHODOLOGY FOR REAL-TIME FLOOD FORECASTING USING STOCHASTIC RAINFALL-RUNOFF MODELING.**
Ghent Rijksuniversiteit (Belgium). Lab. of Hydrology.
For primary bibliographic entry see Field 7C.
W90-01428

**EXTRAORDINARY INFORMATION IN PROBABILITY ESTIMATION METHOD OF FLOOD FREQUENCY ANALYSIS: MONTE CARLO RESULTS.**
Chengdu Univ. of Science and Technology (China). Dept. of Hydraulic Engineering.
For primary bibliographic entry see Field 7C.
W90-01431

**MANAGEMENT OF FORESTS WITH WATER CONSERVATION FUNCTION.**
Vyskumny Ustav Lesneho Hospodarstva, Zvolen (Czechoslovakia).
V. Krecmer, and V. Perina.
IN: Forest Hydrology and Watershed Management. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication No. 167, 1987. p 475-487, 2 fig, 2 tab, 15 ref.

Descriptors: *Czechoslovakia, *Water conservation, *Soil conservation, *Land management, *Forest watersheds, Case studies, Economic aspects, Flood control, Erosion, Water quality, Engineering.

About 44% of the Czech forests serve soil and water conservation objectives that should be taken into account in managing these lands. In three case studies presented, the additional costs to land management for soil and water protection were compared to the cost of remedial engineering measures that would have to be taken to counteract the effects of timber-only management on water quality, erosion or flood flows. In all cases, multipurpose land management proved to be cost effective. (See also W90-01432) (Author's abstract)
W90-01475

**MULTICRITERION FOREST WATERSHED RESOURCES MANAGEMENT.**
Arizona Univ., Tucson. School of Renewable Natural Resources.
For primary bibliographic entry see Field 6A.
W90-01490

**PRINCIPLES OF URBAN HYDROLOGY.**
Gosudarstvennyi Gidrologicheskii Inst., Leningrad (USSR).
V. V. Kurprianov.
IN: Hydrological Processes and Water Management in Urban Areas. Proceedings of the International Symposium 24-29 April 1988, Duisburg, West Germany. International Hydrological Programme of UNESCO Publication, 1988. p 61-67, 5 ref.

Descriptors: *Urban hydrology, *Water resources development, Hydrologic budget, Industrial water, Ecological effects, Hydrologic cycle, Water demand, Runoff.

Urban hydrology is an independent discipline in hydrology with its own subject and investigation method. According to the peculiarities of the water cycle and changes in this cycle, urban hydrology is subdivided into two parts: hydrology of towns and industrial areas; and the hydrology of urban effects on the environment, water resources and water cycle in general. An evaluation is given for the changes in the hydrological cycle, and the

water balance structure is analyzed. Approaches to compute runoff from an urban area in the zone of urban impact, is also discussed. (See also W90-01612) (Author's abstract)
W90-01619

**STOCHASTIC ANALYSIS OF RAINFALL FOR URBAN DRAINAGE STUDIES.**
McGill Univ., Montreal (Quebec).
For primary bibliographic entry see Field 2A.
W90-01621

**DETAILED WATER BUDGET FOR THE CITY OF LUND AS A BASIS FOR THE SIMULATION OF DIFFERENT FUTURE SCENARIOS.**
Lund Univ. (Sweden). Dept. of Water Resources Engineering.
For primary bibliographic entry see Field 6A.
W90-01622

**FLOOD PROTECTION IN THE LOWER RHINE BASIN.**
Staatliches Amt fuer Wasser- und Abfallwirtschaft, Duesseldorf (Germany, F.R.).
For primary bibliographic entry see Field 8A.
W90-01651

**AREA RETENTION USED AS AN ELEMENT FOR THE DESIGN OF URBAN CATCHMENTS.**
Ingenieurburo fuer Wasserwirtschaft, Dreieich, West Germany.
V. Sifalda.
IN: Hydrological Processes and Water Management in Urban Areas. Proceedings of the International Symposium 24-29 April 1988, Duisburg, West Germany. International Hydrological Programme of UNESCO Publication, 1988. p 357-364, 3 fig, 2 tab, 9 ref.

Descriptors: *Catchment basins, *Retention, *Settling basins, *Urban areas, *Drainage systems, *Urban drainage, Sewers, Ponding.

The idea of 'area retention', based on similar principles as the idea of 'ponding', is known as a component of the Frankfurt/Main area airport drainage design. The aim of the application of area retention is to reduce sewer inflow, making it comparable with the outflow rate behind the diversion chambers. This paper presents the mean features of the dimensioning, and the marginal conditions, for an area retention scheme. (See also W90-01612) (Lantz-PTT)
W90-01652

**REVIEW OF PROGRAM 'URBAN HYDROLOGICAL R AND D IN NORWAY 1983-1987'.**
Norges Vassdrags- og Elektrisitetsvesen, Oslo.
For primary bibliographic entry see Field 5D.
W90-01653

**CONCEPTS OF URBAN DRAINAGE AND FLOOD PROTECTION ADOPTED FOR THE CITY OF TOKYO.**
Shibaura Inst. of Tech., Tokyo (Japan).
Y. Takahasi.
IN: Hydrological Processes and Water Management in Urban Areas. Proceedings of the International Symposium 24-29 April 1988, Duisburg, West Germany. International Hydrological Programme of UNESCO Publication, 1988. p 373-379, 1 fig, 2 tab.

Descriptors: *Flood control, *Urban drainage, *Flood protection, *Tokyo, Hydraulic structures, Flood damage, Konda River, Urban hydrology, History.

This paper describes the concepts and methods of urban drainage and flood protection system adopted for the city of Tokyo, Japan, by reviewing the history of flood damages and flood control works in the Kanda River basin, in the heart of the metropolitan area of Tokyo. From the end of the Second World War in 1945 to about 1962, the city of Tokyo experienced a rapid increase in population, from about three to ten million respectively. This resulted in the expansion of the urbanized areas to the lowlands adjacent to rivers and to paddy fields. As a consequence of the rapid urbanization, the newly urbanized areas experienced frequent flood damage since 1958. Currently, these are a series of successful structural and non-structural measures against flood damage implemented in the Kanda River basin. The structural measures includes river improvement works, three huge underground floodways, multi-purpose detention ponds, specially designed sewerage system incorporating pervious sewer pipe, permeable pavements, etc.. Examples of non-structural measures are the announcement of flood-prone areas to the public by the authorities and administrative guidance on, or restriction of, land use. (See also W90-01612) (Author's abstract)
W90-01654

**RAPID REMOVAL OF WATER: A DANGER FOR ALL BODIES OF WATER.**
Emschergenossenschaft und Lippeverband, Essen (Germany, F.R.).
For primary bibliographic entry see Field 5B.
W90-01672

**METHODS OF REDUCING THE STORM SEWAGE OVERFLOWS.**
TAUW Infra Consult B.V., Deventer (Netherlands).
H. B. Weijland, A. L. B. M. Van Campen, and A. J. G. Van der Maarel.
IN: Hydrological Processes and Water Management in Urban Areas. Proceedings of the International Symposium 24-29 April 1988, Duisburg, West Germany. International Hydrological Programme of UNESCO Publication, 1988. p 589-598, 5 fig, 5 ref.

Descriptors: *Urban runoff, *Combined sewer overflows, *Storm water management, *Storm sewers, *Surface-groundwater relations, Water quality, Costs, Hydraulic structures, Water management, Flow control, Outfall sewers.

To control the frequency and volume of storm sewage overflows, methods must be applied to reduce or deaccelerate storm water runoff. This can be achieved by a wide range of storm water management (SWM) systems ranging from separate storm water sewers to storm water infiltration or retention basins. Constraints such as water quality standards, site limitations and management considerations determine the choice of a storm water management system. Special consideration should be given to the use of infiltration systems in urban and industrial areas where a high concentration of pollutants may be present in the storm water runoff. With the decision flow chart and SWM-graphs, the design of a storm water management system can be facilitated. Cost calculations for storm water management systems show that in some cases soak trenches, shallow infiltration basins and roof storage systems provide a good alternative to separate storm water sewers or retention basins. (See also W90-01612) (Author's abstract)
W90-01678

**AQUEDUCT AND VIADUCT: HOW THE RIVER NAHE BECAME MAINSTREET OF IDAR-OBERSTEIN.**
Technische Hochschule Darmstadt (Germany, F.R.). Inst. fuer Wasserbau.
H. Bischoff, and R. Burau.
IN: Hydrological Processes and Water Management in Urban Areas. Proceedings of the International Symposium 24-29 April 1988, Duisburg, West Germany. International Hydrological Programme of UNESCO Publication, 1988. p 629-637, 8 fig, 1 ref.

Descriptors: *Aqueducts, *Water conveyance, *Idar-Oberstein, *West Germany, Nahe River, Hydraulic structures, Channels.

During the last three decades the internal road traffic of the town Idar-Oberstein in West Germany had increased so tremendously, that the main traffic through the only two streets in the steep and narrow valley of the Nahe River nearly collapsed. To solve this problem, different possibilities had been seriously investigated, but finally only one was selected as the most feasible solution to the traffic problems of the town. This decision improved the quality of life for the people who have to live and work in Idar-Oberstein. The Nahe River is the victim of this difficult decision made in 1963. Some of the technical and hydraulic problems are presented in this paper, to give an idea about all of the difficulties the engineers and scientists had to overcome. Over a length of 1900 meters, the Nahe River has been squeezed into an artificial channel topped by the new main street of the town. After 6 years of construction the structure was opened to the public in September 1986. (See also W90-01612) (Lantz-PTT)
W90-01682

**FLOOD PROTECTION PLANTS OF THE CITY OF WASSERBURG A. INN.**
Wasserwirtschaftsamt Rosenheim (Germany, F.R.).
For primary bibliographic entry see Field 4C.
W90-01687

**WATER AND THE URBAN LANDSCAPES IN THE TROPICS: THE EXAMPLE OF LAGOS, NIGERIA.**
Lagos Univ. (Nigeria). Dept. of Geography.
For primary bibliographic entry see Field 3C.
W90-01689

**POSSIBILITIES OF ECOLOGICAL STREAM MAINTENANCE IN URBAN AREAS.**
F. Hemker.
IN: Hydrological Processes and Water Management in Urban Areas. Proceedings of the International Symposium 24-29 April 1988, Duisburg, West Germany. International Hydrological Programme of UNESCO Publication, 1988. p 749-756.

Descriptors: *Water resources development, *Environmental protection, *Ecological effects, *Urban areas, *Water pollution control, *Surface water, Streams, Maintenance, Streambeds, Nitrogen, Phosphorus, Vegetation.

Streams and their bank areas fulfill a great number of social functions in urban areas. While in the past streams were used almost exclusively for the operation of mills, for rafting and fisheries, today there is a greater number of tasks and functions to be fulfilled. The include: abstraction of water for drinking and industrial purposes, discharge of wastewaters of all kinds, function as reaction basin for chemical-biological processes of self purification, use for recreation fisheries, water sports and local recreation, and as a characteristic and vitalizing element of the landscape. The Federal Water Act of the Federal Republic of Germany provides that the interest of the natural budget be taken into account. How this new task can be discharged by those responsible for maintenance, is explained in this paper, and includes: in situ stream maintenance; weed clearance on the streambed; the mowing of reeds, grasses and weeds on banks and slopes; and silt clearance on the streambed, accelerated development of the treatment step for the elimination of phosphate and nitrogen, with the objective of reducing weed growth; construction of storm water treatment plants as well as silt and sand traps to reduce water pollution; re-consideration and, if necessary, modification of older water rights with a view to the present state of technology to improve stream ecology; intensified official monitoring to prevent illegal discharges into the storm water system; and connection of car washing plants only to sewerage systems. (See also W90-01612) (Lantz-PTT)
W90-01696

**STORMWATER MANAGEMENT ALTERNATIVES.**
For primary bibliographic entry see Field 5G.
W90-01919

**CONVIVIAL STORMWATER MANAGEMENT ALTERNATIVES.**
Delaware Univ., Newark. Water Resources Center.
For primary bibliographic entry see Field 5G.
W90-01920

**NATURAL DRAINAGE IN THE WOODLANDS.**
Wallace, McHarg, Roberts and Todd, Philadelphia, PA.
N. Juneja, and J. Veltman.
IN: Stormwater Management Alternatives. Water Resources Center, University of Delaware, Newark, DE. April 1980. p 143-157. 29 fig, 9 ref.

Descriptors: *Water pollution control, *Storm water management, *Urban hydrology, *Urban planning, *Texas, *Community development, Paving, Storm runoff, Environmental protection.

An attempt was made to develop a more satisfactory suburban living environment, other than the one afforded by most of the prevailing developments in the Houston, Texas region. Assembly of significant acreage initiated planning and design for a 20,000 acre tract, which ultimately resulted in the Woodlands, a HUD Title VII new community, located 35 miles north of Houston. A strategy was developed to permit adequate dryness to accommodate the needs of projected human population in the Woodlands in close juxtaposition with the saturated conditions required for survival of the local woodlands. In the end, withholding of runoff by the Woodlands natural drainage and minimization of disturbed areas were extremely valuable in improving stormwater quality. Porous pavings also proved beneficial. (See also W90-01919) (Mertz-PTT)
W90-01931

**IMPLEMENTATION OF STORMWATER MANAGEMENT IN A CANADIAN MUNICIPALITY: THE MARKHAM EXPERIENCE WITH SITE TAILORED CRITERIA.**
Ottawa Univ. (Ontario). Dept. of Civil Engineering.
P. E. Wisner, D. Mukherhjee, and D. Keliar.
IN: Stormwater Management Alternatives. Water Resources Center, University of Delaware, Newark, DE. April 1980. p 159-173, 3 fig, 1 tab, 10 ref.

Descriptors: *Water pollution control, *Storm water management, *Urban hydrology, *Urban planning, *Storm runoff, *Runoff, *Ontario, *Canada, Mathematical studies, Community development.

Based on the experience with several pilot projects, the Town of Markham, Ontario, Canada developed runoff control criteria based on site-specific analysis. The advantages and disadvantages of this approach which may be of interest for comparison with the experience in the application of simpler regulatory measures are discussed by means of examples. The Town Engineers had the difficult task of the implementation of the criteria and stormwater management facilities. The actual design was the result of a cooperative effort of many professionals from various consulting firms and reviewing agencies. The implementation of site tailored criteria and alternative selection on the basis of trade-offs between various objectives was feasible and lead to advantageous and innovative runoff control alternatives. These alternatives comprised traditional drainage, generalized zero runoff increase and partial control, over-control and selective control. Zero runoff increases was considered as a means to achieve environmental and flood control goals but at the current state of the art, there was no justification for a rigid application. Support, involvement and understanding of the issues from the political decision makers was a key factor in the site tailored criteria. Hydrologic analysis by up-to-date methods was also considered essential for the analysis of the simultaneous operation of the major and convenience system. (See also W90-01919) (Mertz-PTT)
W90-01932

**DRAINAGE RECONSIDERED: THE EVOLVING ROLE OF PUBLIC AGENCIES IN DRAINAGE--NEW CASTLE COUNTY, DELAWARE.**
New Castle County Water Resources Agency, Newark, DE.
D. R. Goehring, W. M. Romeika, and V. C. Svatos.
IN: Stormwater Management Alternatives. Water Resources Center, University of Delaware, Newark, DE. April 1980. p 185-209. 9 fig, 8 tab, 11 ref.

Descriptors: *Water pollution control, *Storm water management, *Urban hydrology, *Detention reservoirs, *Storm runoff, *Urban runoff, *Delaware, *Urban planning, Flood control, Water pollution control, New Castle County, Cost analysis, Environmental protection.

On innovation in stormwater management (i.e. zero runoff) was the natural drainage concept which emphasized the detention or storage of rainfall where it fell. This practice was expected to reduce drainage and flood protection costs, improve water quality, and augment groundwater supplies. Reduced liability costs and increased assets of urban runoff were the new goals. New Castle County, Delaware's experience showed how a local government developed a drainage program including the philosophical, technical and legislative underpinnings of the program. As the County responded to environmental needs, it was able to maintain the flexibility to cope with individual land use decisions and, in a continuous manner, evaluate its performance and set new directions. The experience illustrated the need for local governments to balance the creation of hospitable environments in which innovative stormwater management techniques could thrive with the assurance of safety for its citizens. (See also W90-01919) (Mertz-PTT)
W90-01934

**AREAWIDE AND LOCAL FRAMEWORKS FOR URBAN NONPOINT POLLUTION MANAGEMENT IN NORTHERN VIRGINIA.**
Northern Virginia Planning District Commission, Annandale.
For primary bibliographic entry see Field 5G.
W90-01935

**LET'S SETTLE THE STORMWATER MANAGEMENT ISSUE.**
North Carolina Dept. of Natural Resources and Community Development, Raleigh.
For primary bibliographic entry see Field 5G.
W90-01939

**GREENWAY CONCEPT WITHIN THE HERITAGE CONSERVATION AND RECREATION SERVICE.**
Heritage Conservation and Recreation Service, Philadelphia, PA.
G. Eugster, and E. Titus.
IN: Stormwater Management Alternatives. Water Resources Center, University of Delaware, Newark, DE. April 1980. p 287-308. 1 fig.

Descriptors: *Water pollution control, *Storm water management, *Urban hydrology, *Conservation, Heritage Conservation and Recreation Service, Department of the Interior, Institutions, Rivers.

The U.S. Department of the Interior's Heritage Conservation and Recreation Service, through the Nationwide Rivers Inventory, established a comprehensive river information system which served as a framework and a focal point for greenway conservation activities. The Inventory, being conducted under the National Wild and Scenic Rivers Act, did several things. (1) It provided recognition and the option for varying degrees of protection to significant river resource areas to avoid adverse environmental impacts and to upgrade the public's awareness of these valuable resources. (2) It served as a focal point for the more effective coordination and use of existing Federal activities and programs related to greenway conservation. (3) It established a data base of objectives and descriptive river resource information for planning and decision making. (4) It identified through the use of a grassroots communication network, opportunities for greenway conservation implementation including information about local and State issues and conservation supporters. (5) It identified and emphasized greenway conservation implementation options at all levels of the government and the private sector including funding programs, legislative tools and techniques, and less-than-fee-acquisition strategies. The Heritage Conservation and Recreation Service's national greenway conservation effort was based on the philosophy that river conservation is a shared responsibility between all levels of the government and the private sector. (See also W90-01919) (Author's abstract)
W90-01940

**UNCOUNTED COSTS OF UNCONTROLLED WATER.**
Chester County Conservation District, West Chester, PA.
For primary bibliographic entry see Field 6E.
W90-01942

**PUBLIC PARTICIPATION IN ANNE ARUNDEL COUNTY'S WATER SHED MANAGEMENT PROGRAM.**
Anne Arundel County Office of Planning and Zoning, Annapolis, MD.
For primary bibliographic entry see Field 4D.
W90-01943

## 4B. Groundwater Management

**MANAGING GROUND WATER QUALITY IN RELATION TO AGRICULTURAL ACTIVITIES.**
Maryland Univ., College Park. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 5G.
W90-00975

**PALEOHYDROLOGY AFFECTING RECHARGE TO OVEREXPLOITED SEMICONFINED AQUIFERS IN THE MEHSANA AREA, GUJARAT STATE, INDIA.**
For primary bibliographic entry see Field 2F.
W90-01033

**WASTE DISPOSAL AND GROUNDWATER MANAGEMENT.**
Binnie and Partners, Redhill (England).
For primary bibliographic entry see Field 5E.
W90-01078

**WYOMING'S GROUNDWATER LAWS: QUANTITY AND QUALITY REGULATION.**
Holland and Hart, Cheyenne, WY.
For primary bibliographic entry see Field 6E.
W90-01125

**GROUNDWATER LOWERING IN THE FOUNDATION PIT OF THE KAISIADORYS PUMPED-STORAGE STATION.**
For primary bibliographic entry see Field 8A.
W90-01198

**RAINFALL PROBABILITY FORECASTS USED TO MANAGE A SUBDRAINAGE-SUBIRRIGATION SYSTEM FOR WATERTABLE CONTROL.**
Agricultural Univ., Wageningen (Netherlands). Dept. of Hydraulics and Catchment Hydrology.
For primary bibliographic entry see Field 3F.
W90-01221

**WATER BENEATH THE CITY STREETS.**
Moretrench American Corp., Rockaway, NJ.
J. P. Powers, and R. G. Lenz.
Civil Engineering (ASCE) CEWRA9, Vol. 59, No. 8, 1989, p 62-64.

Descriptors: *Groundwater barriers, *Water management, *Control systems, Urban areas, Pumping, Cutoffs, Construction methods.

Groundwater control has been complicated by underground utility lines, water pipes and sewers, subways and building foundations. There are four basic groups of groundwater control methods: (1) Open pumping--water allowed to flow into the proceeding excavation, collects in ditches and is pumped away; (2) Predrainage--lowers the water via pumped wells, wellpoints or ejectors prior to excavation; (3) Cutoff--groundwater flow to the excavation site is prevented with steel sheeting, slurry concrete walls, secant piles, etc.; (4) Exclusion--compressed air or closed face tunnel shield keep groundwater from the excavation. Success often requires a combination of two methods. Problems with controlling groundwater, factors which complicate groundwater control in urban settings, and the damages which can be caused by improperly executed methods are briefly discussed. Examples of errors in urban areas are cited and suggestions for solving such problems and mistakes are included. (Male-PTT)
W90-01267

**BEATING THE PEAK IN SUMMER DEMAND.**
CH2M Hill, Inc., Austin, TX.
For primary bibliographic entry see Field 5F.
W90-01382

**SNOW REDISTRIBUTION: STRIP CUTS AT YUBA PASS, CALIFORNIA.**
Pacific Southwest Forest and Range Experiment Station, Berkeley, CA.
B. J. McGurk, and N. H. Berg.
IN: Forest Hydrology and Watershed Management. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication No. 167, 1987. p 285-295, 3 fig, 5 tab, 6 ref.

Descriptors: *Water yield improvement, *Snow depth, *Forest management, *Forest hydrology, Cutting management, California.

Five east-west strips were harvested in 1962 to test the potential for snow redistribution in California's snow zone. Snow depth and water equivalent data were collected from 1962 through 1964 and again from 1982 through 1984. In both sets of measurements, the average absolute depths and snow water equivalents were generally significantly greater in the strip cuts than in the forest. Strips on tree height in width had deeper snow and more water than strips two tree heights wide. Although snow redistribution did occur, an early summer survey indicated that snow in the cut strips melted much faster than that in the forest. It appears that either the strips were too wide to adequately shade the snowpack, or the east-west orientation of the strips was incorrect. Because no stream gauge was installed, whether the observed snow redistribution had any effect on runoff volumes or timing cannot be determined. (See also W90-01432) (Author's abstract)
W90-01459

**EVALUATION OF THE HYDROLOGICAL RESPONSE OF A DRAINAGE NETWORK.**
Ecole Polytechnique Federale de Lausanne (Switzerland). Inst. for Agricultural Engineering.
For primary bibliographic entry see Field 2A.
W90-01596

**EFFECTS OF BANKWELL FILTRATION ON THE SAFE GROUND WATER YIELD IN THE COLOGNE AREA.**
W. Lindner.
IN: Hydrological Processes and Water Management in Urban Areas. Proceedings of the International Symposium 24-29 April 1988, Duisburg, West Germany. International Hydrological Programme of UNESCO Publication, 1988. p 437-443, 4 fig, 2 ref.

Descriptors: *Surface-groundwater relations, *Bank storage, *Conjunctive use, *Groundwater budget, *Groundwater management, *Wells, Cologne, Rhine River, Groundwater recharge, Sedimentation, Geohydrology.

The replenishment of groundwater due to precipitation does not meet the demanded withdrawal rates of groundwater in many regions of the Rhine River valley. Industries and municipal water supplies, therefore, also rely on bankwell filtration. The management of groundwater resources requires more information about the possibilities of extending the utilization of groundwater, whether the present amount of bankwell withdrawal can also be gained in the future, and what the effects of bankwell filtration are on the permeability of the Rhine River bed. To answer these questions, a numerical two-dimensional horizontal model was applied which stimulates the transient groundwater flow, takes local and time dependent variations of the water level in the Rhine River into consideration, and finally computes the permeability of the Rhine River bed. This study does not prove that high water in the Rhine River effects the permeability of the river bed, nor can the results be explained by backwash effects or cleaning the pores in the river bed; there was hardly any seepage of groundwater into the Rhine. It may be assumed though, that the clogging of the river bed due to the potential migration of microparticles into the bottom stratum of the river bed is superimposed by a simultaneous break-up of the river bed bottom due to erosion. In the long term, the safe yield of bankwell water will not be reduced. Losses in permeability of the Rhine River bed can occur in dry years, but are reversible under normal hydrological conditions. (See also W90-01612) (Lantz-PTT)
W90-01661

**STUDIES ON SUBSURFACE WATER POTENTIAL AND QUALITY FOR IRRIGATION.**
Karnataka Regional Engineering Coll., Suratkal (India).
G. Ranganna, M. R. Gajendragad, C. Naganna, K. M. Gurappa, and I. V. Nayak.
IN: Irrigation and Water Allocation. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication no. 169, 1987. p 49-58. 2 fig, 6 tab, 5 ref.

Descriptors: *Water resources development, *Groundwater potential, *Groundwater quality, *Irrigation, *India, Aquifer characteristics, Satellite technology, Soil-water-plant relationships, Water demand, Hydrologic data collections, Geohydrology.

The region of Western Ghats comprising the Sahyadri Mountain chain in southern India has remained underdeveloped notwithstanding its rich natural resources and flora and fauna. Although the Aladangadi Hole (river) basin receives very heavy rainfall, it faces water scarcity problems and thus has remained undeveloped. Intense development in the coastal region has created increasing demands for fresh water. As a pilot study, hydrological investigations for the yield, quality of water and soil, aquifer parameters, soil-water-crop compatibility, groundwater potential and Landsat imagery studies were undertaken. Results of these studies indicate that to utilize the surplus groundwater in the Aladangadi Hole basin, 350 additional wells can be sunk in the vicinity of the lineaments to tap groundwater at an optimum level. The irrigation activities can then be extended and some virgin lands brought into cultivation. These developments would increase food production and job opportunities. (See also W90-01828) (Geiger-PTT)
W90-01833

**EFFECT OF IRRIGATION METHODS ON GROUNDWATER LEVELS IN GLACIATED TERRAIN.**
Agriculture Canada, Lethbridge (Alberta). Research Station.
For primary bibliographic entry see Field 3F.
W90-01837

**OVER-IRRIGATION OF PADDY FIELDS FOR THE PURPOSE OF ARTIFICIALLY RECHARGING GROUNDWATER IN THE CONJUNCTIVE USE SCHEME OF THE CHO-SHUI RIVER BASIN.**
National Taiwan Univ., Taipei. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 3F.
W90-01838

**DETERMINATION OF THE NECESSARY VOLUME OF THE GROUNDWATER RESERVOIRS FOR OPTIMAL CONJUNCTIVE WATER USE FOR IRRIGATION IN AN ARID REGION.**
Hanover Univ. (Germany, F.R.). Inst. fuer Grundbau, Bodenmechanik und Energiewasserbau.
N. R. Correa.
IN: Irrigation and Water Allocation. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication no. 169, 1987. p 221-228. 5 fig, 3 ref.

Descriptors: *Irrigation requirements, *Irrigation efficiency, *Groundwater recharge, *Conjunctive use, *Arid lands, Water demand, Safe yield, Optimization, Percolation, Artificial recharge, Water management, Surface runoff.

The interactions between the variables of the groundwater balance equation were investigated in order to determine the minimum necessary volume of the groundwater reservoirs for optimal conjunctive use in an arid region. To establish the long-term groundwater recharge policy for a given volume of the groundwater reservoirs and water demand, the condition of the long-term equilibrium of the groundwater reservoirs (safe yield) was applied. As a result of the investigation, the necessary groundwater volume for optimal conjunctive use and the associated groundwater recharge policy to be applied for a desired water demand in the system are given. As an example, the investigation area in the valley of Tulum in the Andine region near San Juan, Argentina is discussed. In this valley, groundwater and surface water of the San Juan River are used conjunctively for irrigation and other purposes. Results of managing the surface seasonal reservoir for a given water surplus volume in the study area showed that the relation between minimum and maximum percolation from the river has a mean value of 0.65. This value depends on the regulation capacity of the surface reservoirs. The larger the regulation capacity, the smaller this value. (See also W90-01828) (Geiger-PTT)
W90-01848

## 4C. Effects On Water Of Man's Non-Water Activities

**DESIGN OF A DIVERSION SYSTEM TO MANAGE THE FIRST FLUSH.**
Virginia Polytechnic Inst., Blacksburg. Dept. of Civil Engineering.
For primary bibliographic entry see Field 4A.
W90-00965

**EFFECTS OF PLACER MINING DISCHARGE ON HEALTH AND FOOD OF ARCTIC GRAYLING.**
Alaska Cooperative Fishery Research Unit, Fairbanks.
For primary bibliographic entry see Field 5C.
W90-00978

**IMPACT OF HIGHWAY CONSTRUCTION ON LEAF PROCESSING IN AQUATIC HABITATS OF EASTERN TENNESSEE.**
Tennessee Technological Univ., Cookeville. Dept. of Biology.
B. M. Stout, and C. B. Coburn.
Hydrobiologia HYDRB8, Vol. 178, No. 3, p 233-242, Jul 17 1989. 2 fig, 4 tab, 40 ref. Tennessee Department of Transportation grant 80-9-3.

Descriptors: *Tennessee, *Highway effects, *Riparian vegetation, *Leaves, *Road construction, *Litter, *Leaf processing, *Decomposition, *Aquatic habitats, *Streams, *Ponds, *Riffles, Oak trees, Hydrogen ion concentration, Water temperature, Macroinvertebrates, Leaves.

Rates of leaf litter processing at 8 sites were used in conjunction with other methods to evaluate the impact of highway construction on aquatic habitats. Monthly processing of white oak leaves from 4 different mesh size bags at unimpacted reference sites indicated that the 3 larger mesh sizes were useful for comparing sites, as they did not restrict invertebrate colonization and provided similar rates of processing within sites. Small mesh size (0.12 mm) prevented leaf shredding macroinvertebrates from colonizing bags, and caused significantly slower leaf processing in a riffle. Leaf processing was fastest in a reference riffle above an area of highway construction but was significantly slower in the reference pool due to low current velocity and the absence of shredders. Leaf processing in a riffle below the highway was slower than the reference riffle, and the number of shredders was reduced. Removal of streamside vegetation during highway construction caused increased stream temperatures and reduced the amount of natural leaf accumulations, thereby reducing shredder habitat. At other sites highway construction caused less of an impact than preexisting environmental influences. Leaf processing in a riffle of lower pH stream was significantly slower than in the reference riffle. Shredders were absent from the low pH stream, and rates of leaf processing in the acid impacted riffle and pool were similar to those of the reference pool. Comparisons of the low pH stream with the reference stream indicated that physical processes were less important than biological processes of leaf decay. Leaf processing in ponds was similar to that of stream ponds. Processing was faster in a small vs. large ponds, and a high density of invertebrates was associated with leaf bags in the small pond after one year. (Author's abstract)
W90-01016

**RESPONSE OF HEADWATER STREAM CHANNELS TO URBANIZATION IN THE HUMID TROPICS.**
Ondo State Univ., Ado-Ekiti (Nigeria). Dept. of Geography.
F. S. Ebisemiju.
Hydrological Processes HYPRE3, Vol. 3, No. 3, p 237-253, Jul-Sep 1989. 7 fig, 4 tab, 52 ref.

Descriptors: *Urban hydrology, *Urbanization, *Urban drainage, *Storm runoff, *Tropical regions, *Sedimentation, *Nigeria, Channel accretion, Headwaters, Discharge capacity, Waste disposal, Channel morphology, Flow velocity, Low flow.

Analysis of the bankfull cross-sections of headwater streams in Ado-Ekiti region of Southwestern Nigeria and their comparison with data from other tropical environments and temperate latitudes reveal that the channel capacities of streams in the humid tropics are relatively smaller than those of temperate regions. This is attributed to the small stream discharge, the predominately low and highly seasonal flows of the streams, the low shear stress of stream load, and the stabilizing and protective influence of riparian vegetation and surface incrustations. The channel capacities of the urban streams (mean = 1.13 sq m) are about 47% smaller than those of the natural streams (mean =2.12 sq m) in the same ecological zone. Resurveys of seventeen cross-sections reveal that while channel shoulder width increased by only 6% over a one-year period, channel depth and capacity decreased by 16% and 4% respectively; the decrease in channel size occurs entirely in the channel depth dimension. Thus the response of stream channels to the urbanization of small headwater catchments in the humid tropics is probably more of vertical accretion of channel bed and reduction in channel capacity rather than the enlargement of urban streams through channel widening. The rapid rate of channel aggradation is attributed to excessive rates of sediment production, rapid deposition of sediments during small runoff events and on the falling stage of storm hydrographs, and the inability of the streams to evacuate the sediments delivered to them despite the increased discharge and peak flow associated with urbanization. The low competence of the urban streams is attributed to predominance of low flows, very gentle bed slopes, and most importantly the widespread dumping of refuse into channels thereby reducing flow velocity and promoting backwater flooding, ponding, and sedimentation. Spatial variations in the degree of urbanization of the catchments, and therefore in runoff volume and velocity, exercise strong control on channel width, depth and size. A model of the sequence of stream channel adjustment to the urbanization of small headwater catchments in the humid tropics is presented. (Author's abstract)
W90-01074

**CATCHMENT AFFORESTATION AND WATER SUPPLY IN STRATHCLYDE REGION.**
Strathclyde Regional Council, Glasgow (Scotland). Water Dept.
L. A. Greene, and J. A. Taylor.
Journal of the Institution of Water and Environmental Management, Vol. 3, No. 3, p 288-294, June 1989. 3 fig, 5 tab, 12 ref.

Descriptors: *Watershed management, *Water yield, *Forest hydrology, *Reforestation, *Water supply development, *Land use, *Water quality management, *Catchment areas, Forest watersheds, Water quality standards, Color, Turbidity, Acidity, Aluminum, Access routes, Cultivation, Drainage, Leaching, Phosphates, Fertilization, Planning, Water costs, Scotland.

The intensive afforestation of the uplands in Strathclyde Region, Scotland, encouraged by Government policy, has given rise to growing concern about the impact of this significant change in land use on the quality and quantity of water supplies. The smaller high-quality upland sources, which historically have minimal treatment, are those most at risk from changes as a result of forestry activity. Problems caused by a reduction in yield at some sources in the Region are discussed. A number of afforested water-supply catchments have been monitored since 1984 with the aim of identifying trends in water quality, and the results indicate increases in color, turbidity, acidity, and aluminum in supplies after activities such as access road construction, plowing, and draining. Evidence has presented of the continued leaching of phosphate more than six years after the application of fertilizer. To enable improved advance consultation and planning to protect public water supplies, there is a requirement to be able to indicate the likely sensitivity of individual supplies to the various effects of afforestation. The Region is committed to a substantial ten-year capital expenditure program to upgrade water treatment works to comply with the recent European Community water supply standards imposed in 1985. Any significant long-term changes in water quality associated with forestry activity will make this program more costly to achieve. (Author's abstract)
W90-01097

**SURVIVAL OF AND PLASMID STABILITY IN PSEUDOMONAS AND KLEBSIELLA SP INTRODUCED INTO AGRICULTURAL DRAINAGE WATER.**
Guelph Univ. (Ontario). Dept. of Environmental Biology.
For primary bibliographic entry see Field 5B.
W90-01110

**RESPONSE OF A FRESHWATER MARSH PLANT COMMUNITY TO INCREASED SALINITY AND INCREASED WATER LEVEL.**
Louisiana State Univ., Baton Rouge. Center for Wetland Resources.
For primary bibliographic entry see Field 2H.
W90-01307

**URBAN HYDROLOGY PROCESSES AND MODELING.**
Purdue Univ., Lafayette, IN. School of Civil Engineering.
J. W. Delleur.
IN: Computer Methods and Water Resources: First International Conference, Morocco, 1988. Vol. 3, Computational Hydrology. Computational Mechanics Publications, Boston. 1988. p 159-181, 4 fig, 5 tab, 13 ref.

Descriptors: *Urban hydrology, *Urban runoff, *Urban watersheds, *Hydrologic models, *Model studies, Infiltration, Urban drainage, Runoff, Rainfall-runoff relationships, Hydrologic properties, Flood peak, Catchment areas, Hydrographs.

The runoff in urbanized areas is affected by two principal factors: the decrease in infiltration and depression storage, and the increased conveyance of the drainage system. This results in an increased volume of runoff with a larger peak flow occurring at an earlier time, and in the transport of pollutants to the receiving waters. Measures for reducing and controlling urban runoff are discussed, including control on large flat roofs, parking lots, residential plots, structural and non-structural measures at the source, along the line, and at the end of the line. The principles of models for the simulation of urban runoff systems are summarized, including the macro approach, where only the relevant characteristic of a system are retained in a cause-effect of input-output pattern, and the micro approach, where all the physical properties involved in the system or modeled in detail. A short description of the storm water management model (SWMM) is presented. The model is configured with six blocks, the executive, runoff, transport, extended, receiving water, and storage/treatment block. The most important part of the calibration of SWMM occurs in the runoff block, which generates the hydrograph of each subcatchment. An application of expert system technology for the calibration of SWMM is presented. (See also W90-01409)(Friedmann-PTT)
W90-01423

**FOREST HYDROLOGY AND WATERSHED MANAGEMENT.**
For primary bibliographic entry see Field 4D.
W90-01432

**RUNOFF AND EROSION IN CLEARINGS FOLLOWING CUTTING OF THE HUMID TROPICAL FOREST (ECOULEMENTS ET EROSION SOUS PRAIRIES ARTIFICIELLES APRES DEFRICHEMENT DE LA FORET TROPICALE HUMIDE).**
Office de la Recherche Scientifique et Technique Outre-Mer, Cayenne (French Guiana).
J. M. Fritsch.
IN: Forest Hydrology and Watershed Management. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication No. 167, 1987. p 123-129, 4 fig, 2 tab, 8 ref. English Summary.

Descriptors: *Rainfall-runoff relationships, *Soil erosion, *Forest management, *Deforestation, *Erosion, *Runoff, Cover crops, Catchment areas.

Increases in runoff and erosion on two small drainage basins were detected, using the paired watershed method, after replacing the amazonian forest cover with grass. One basin, with impervious soils, received a Digitaria swazilandensis cover. Annual runoff increased by a factor of 1.7 peak discharge by 1.9, while erosion increased by 3.2. The other basin, with pervious soils, was planted with Brachiaria USDA, and relative increases of annual runoff, peak discharges, and erosion were 2.9, 2.4 and 2.4, respectively. (See also W90-01432) (Author's abstract)
W90-01443

**POSSIBLE HYDROLOGICAL AND GEOMORPHOLOGICAL CHANGES DUE TO ALTERATION OF FOREST.**
Kyoto Univ. (Japan).
K. Okunishi, T. Saito, and H. Yoshioka.

IN: Forest Hydrology and Watershed Management. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication No. 167, 1987. p 173-179, 3 fig, 8 ref.

Descriptors: *Forest management, *Erosion control, *Landslides, *Reforestation.

Effects of the alteration of forest were examined in a small basin. Abandoned broad-leaved trees were replaced with Japanese cedars. In clearing economically useless trees, protective measures against erosion and landslides, which had been learned from the past devastation due to forest destruction, were taken. In a period of 14 yrs after the forest alteration, small scale landslides took place with no greater density than in the control forests. Accelerated surface erosion was negligible. There remain, however, possibilities of forest devastation. A uniform forest of coniferous trees is susceptible to a great swarm of landslides, and the harvesting of Japanese cedars will cause more landslide that the present case because of the absence of shrubs. To assess the long term effects of human interference on the forests, the interaction between ecosystem and hydrogeomorphological system should be analyzed. (See also W90-01432) (Author's abstract)
W90-01448

**EVALUATION OF THE EFFECT OF DEFORESTATION ON SLOPE STABILITY AND ITS APPLICATION TO WATERSHED MANAGEMENT.**
Tokyo Univ. of Agriculture and Technology (Japan). Dept. of Forestry.
Y. Tsukamoto, and H. Minematsu.
IN: Forest Hydrology and Watershed Management. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication No. 167, 1987. p 181-189, 5 fig, 2 tab, 6 ref.

Descriptors: *Soil erosion, *Forest management, *Forest hydrology, *Watershed management, *Deforestation, *Erosion, Soil depth.

The effect of tree roots on slope stability was evaluated with the upper bound theorem. The greatest effect is indicated in mature forests where the surface soil depth is < 100 cm. The critical soil depth is estimated as an index of instability of surface soils. All major factors affecting the stability of surface soils are discussed and summarized in a table for practical watershed management. (See also W90-01432) (Author's abstract)
W90-01449

**INFILTRATION AND REDISTRIBUTION OF OVERLAND FLOW AND SEDIMENT ON A LOW RELIEF LANDSCAPE OF SEMI-ARID, TROPICAL QUEENSLAND.**
James Cook Univ. of North Queensland, Townsville (Australia). Dept. of Geography.
For primary bibliographic entry see Field 2E.
W90-01451

**EFFECT OF DIFFERENT TYPES OF FOREST MANAGEMENT ON THE TRANSFORMATION OF RAINFALL ENERGY BY THE CANOPY IN RELATION TO SOIL EROSION.**
Silsoe Coll. (England). Dept. of Field Engineering.
For primary bibliographic entry see Field 4D.
W90-01452

**STUDIES ON THE HYDROLOGICAL PROCESSES IN THE FOREST DRAINAGE BASINS OF THE WESTERN GHATS OF INDIA.**
Centre for Water Resources Development and Management, Calicut (India).
E. J. James, P. K. Pradeepkumar, G. Rangana, I. V. Nayak, and T. B. Ravi.
IN: Forest Hydrology and Watershed Management. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication No. 167, 1987. p 223-229, 6 fig, 2 tab, 2 ref.

Descriptors: *Soil erosion, *Erosion, *India, *Forest hydrology, *Deforestation, *Sediment yield, *Unit hydrographs, Catchment areas, Evapotranspiration.

Three sets of drainage basins of about 2 sq km have been monitored for two yrs to study the impact of deforestation on hydrological parameters in the Western Ghats region of India. Each set consisted of separate dense forest, partially exploited and fully exploited basins. Unit hydrographs have been evolved for each of the drainage basins and compared. An average interception loss of about 10% was observed in the forest basins. Sediment yield from exploited basins was computed as four times more than that of forest basins. Potential evapotranspiration was found to be more from the exploited basins. (See also W90-01432) (Author's abstract)
W90-01453

**AMOUNT OF RUNOFF AND SOIL LOSSES FROM VARIOUS LAND-USE SAMPLING PLOTS IN SAKOLNAKORN PROVINCE, THAILAND.**
W. Putjaroon, and K. Pongboon.
IN: Forest Hydrology and Watershed Management. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication No. 167, 1987. p 231-238, 2 tab, 11 ref.

Descriptors: *Land use, *Soil erosion, *Surface runoff, *Forest hydrology, *Thailand, Erosion control.

Six 2x10 m runoff plots were set up in dry dipterocarp forest, abandoned fields and contour furrowing agriculture. Each area had similar slope and aspect. The average soil losses from dry dipterocarp forest, open land forest and contour furrowing agriculture were 664, 1,425 and 439 kg/ha respectively. Average runoff from dry dipterocarp forest, abandoned fields and contour furrowing agriculture was 1,529, 2,702 and 1,317 cu m/ha respectively. Abandoned fields averaged 2.15 times the soil losses and 1.77 times the surface runoff of forest land. To reduce the soil losses and runoffs from open land, proper land management or soil erosion control methods such as control furrowing agriculture were shown to be effective. (See also W90-01432) (Author's abstract)
W90-01454

**DEFORESTATION AND EROSION IN THE NEPALESE HIMALAYA--IS THE LINK MYTH OR REALITY.**
Land Capability Consultants Ltd., Cambridge (England).
For primary bibliographic entry see Field 2J.
W90-01455

**EFFECTS OF FORESTS ON WETLAND RUNOFF DURING SPRING.**
McMaster Univ., Hamilton (Ontario). Dept. of Geography.
For primary bibliographic entry see Field 2A.
W90-01460

**EFFECT OF CLEARCUTTING ON CHEMICAL EXPORTS IN LATERAL FLOW FROM DIFFERING SOIL DEPTHS ON A SUBALPINE FORESTED SLOPE.**
Forest Service, Fort Collins, CO.
C. Troendle, and M. A. Nilles.
IN: Forest Hydrology and Watershed Management. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication No. 167, 1987. p 423-431, 6 fig, 2 tab, 8 ref.

Descriptors: *Water chemistry, *Water pollution sources, *Clear-cutting, *Runoff, *Surface runoff, *Surface flow, Nitrates, Chlorides, Geochemistry, Monitoring, Alpine regions.

Chemistry of lateral flow from the surface and subsurface depths on two study plots at the Fraser Experimental Forest has been measured for 5 yrs. Following the third year, one plot was clearcut. The calibration period data were useful in refining the definition of the dominant flow mechanisms and pathways of travel during the snowmelt season. Clearcutting the smaller plot increased chemical export, both because two elements, NO-3 and Cl-, increased in concentration and because the greater flow following harvest 'flushed' more material from the system. (See also W90-01432) (Author's abstract)
W90-01471

**HYDROLOGY OF AN ACID WETLAND BEFORE AND AFTER DRAINING FOR AFFORESTATION, WESTERN NEW ZEALAND.**
New Zealand Forest Service, Rotorua. Forest Research Inst.
R. J. Jackson.
IN: Forest Hydrology and Watershed Management. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication No. 167, 1987. p 465-474, 2 tab, 8 ref.

Descriptors: *Forest hydrology, *Land reclamation, *Wetlands, *New Zealand, *Acid streams, *Planting management, Pine trees, Drainage, Precipitation, Runoff, Flood peak, Sediment yield.

An intensive surface drainage system is used to improve establishment of plantations of Pinus radiata on wetlands in western South Island, New Zealand. Downstream impacts of such drainage were assessed by comparing undisturbed and drained wetland basins in an area with 2440 mm/yr rainfall. Stream water is brown, naturally acid (pH c. 4.0), and has high concentrations of dissolved organic C (25-55 mg/L). The water table on undisturbed wetland was nearly always at <0.5 m depth and rose rapidly during rainfall to give widespread overland flow. Quickflow contributed 70% of the 1580 mm/yr runoff. The ridges formed by surface drainage works provided elevated, drier sites for trees, but the water table remained high beneath and between ridges. Drainings have higher flood peaks, and the frequency of peaks >10 L/s/ha increased greatly. Annual sediment yield increased from <1 to c. 10 t/ha. Increased peak flows caused instability of the channel downstream from the drained area.(See also W90-01432) (Author's abstract)
W90-01474

**DISSOLVED ORGANIC CARBON IN FORESTED AND CUTOVER DRAINAGE BASINS, WESTLAND, NEW ZEALAND.**
McGill Univ., Montreal (Quebec). Dept. of Geography.
T. R. Moore.
IN: Forest Hydrology and Watershed Management. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication No. 167, 1987. p 481-487, 1 fig, 2 tab, 15 ref.

Descriptors: *Water pollution sources. *New Zealand, *Forest watersheds, *Forest management, *Water quality, *Organic carbon, Detritus, Soil properties, Hydrological regime, Catchment areas, Stream discharge.

Dissolved organic carbon (DOC) is an important component of water quality yet there are few studies of the effect of forest management on DOC and these have contradictory conclusions. Studies of DOC were conducted over 5 months at two sets of basins near Reefton, South Island, New Zealand. The Maimai set of 8 steep well-drained basins had stream DOC positively related to discharge and with the cutover basins having higher DOC values than the two controls. In-channel debris and the burning of slash appeared to be major controls on the stream DOC levels. The Larry River set of 3 flat, poorly drained basins had DOC concentrations of 25-55 microg/L with a negative relationship with discharge and with the drained and planted basins lower in stream DOC than the control. Differences in DOC fluxes between the two sets and between the undisturbed and disturbed basins can be related to differences in hydrologic regime and soil characteristics. (Author's abstract)
W90-01476

**REFORESTATION: ON-SITE EFFECTS ON HYDROLOGY AND EROSION, EASTERN RAUKUMARA RANGE, NEW ZEALAND.**
New Zealand Forest Service, Rotorua. Forest Research Inst.
A. J. Pearce, C. L. O'Loughlin, R. J. Jackson, and X. B. Zhang.
IN: Forest Hydrology and Watershed Management. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication No. 167, 1987. p 489-497, 1 fig, 14 ref.

Descriptors: *Rainfall-runoff relationships, *New Zealand, *Runoff, *Forest watersheds, *Erosion, *Reforestation, Surface flow, Soil erosion, Clays, Shales, Sandstones.

Reforestation with Pinus radiata plantations on rapidly eroding hill country underlain by clay-rich shales and fine sandstones has reduced annual runoff by 170-400 mm/yr. Soil water contents are lower than under pasture for most of the year, with a 3-4 month winter period of high soil water content compared to 6-8 months before reforestation. Interception loss in the forest canopy is the principal contributing factor. Roots of mature stands have penetrated the upper 1-1.5 m of earth flows, which are typically 5-7 m thick. Earth flow movement rates and erosion by earth flows have decreased by a factor of about 10 because of the lower soil water contents and the effects of tree roots in creating a reinforced, semi-rigid upper layer of the flows. Reforestation has had little effect on erosion by isolated, large gully-mass movement complexes, which continue to supply large sediment volumes to rivers. (See also W90-01432) (Author's abstract)
W90-01477

**CHANGES IN STREAMFLOW PEAKS FOLLOWING TIMBER HARVEST OF A COASTAL BRITISH COLUMBIA WATERSHED.**
British Columbia Univ., Vancouver. Faculty of Forestry.
D. L. Golding.
IN: Forest Hydrology and Watershed Management. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication No. 167, 1987. p 509-517, 2 fig, 15 ref.

Descriptors: *Forest hydrology, *Rainfall-runoff relationships, *Forest management, *Clear-cutting, *Storm runoff, *British Columbia, Flood peak, Snowmelt, Streamflow, Precipitation.

Changes in streamflow peaks following clearcutting of 19.2% of Jamieson Creek experimental basin were determined using the paired-basin approach. Winter storm peaks, which usually result from rain on melting snowpacks, showed a treatment-induced increase of a maximum 13.5%. There was no indication that the increases were limited to a particular storm-size class. Summer storm peaks showed no treatment-induced increase, although both summer and winter storms showed significant post-treatment increase, presumably from changes in precipitation patterns resulting in storms of greater total precipitation. Peak winter flows were highly correlated with snowmelt rates. There was no difference in size of peak flow or in lag time between peak snowmelt and peak streamflow whether or not melt rates were greater in the forest than in the clearcut. (See also W90-01432) (Author's abstract)
W90-01479

**SOURCE OF INCREASED STORMWATERS AFTER FOREST OPERATIONS.**
Virginia Polytechnic Inst. and State Univ., Blacksburg. School of Forestry.
L. Chiun-Ming.
IN: Forest Hydrology and Watershed Management. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication No. 167, 1987. p 539-544, 10 ref.

Descriptors: *Forest hydrology, *Rainfall-runoff relationships, *Forest management, *Clear-cutting, *Storm runoff, *Flood peak, Vegetation, Transpiration, Soil water, Statistical analysis, Terrain classification, Model studies.

Twelve segments were selected from two experimental basins to identify the cause and source of increases in stormflow and peakflow from a treatment basin after forest operations. The removal of vegetation did not greatly alter the infiltration charateristics of the experimental watershed. The most signigicant response to the clearcutting was the reduction in transpiration. This resulted in higher soil water storage, which in turn resulted in greater stormflow. The results of statistical analyses showed that convergent segments were more responsive to forest practices than the rest of the basin. This implies that more emphasis should be placed on terrain classification for management prescriptions. (See also W90-01432) (Author's abstract)
W90-01482

**EFFECT OF CLEARCUTTING ON STREAMFLOW GENERATING PROCESSES FROM A SUBALPINE FOREST SLOPE.**
Forest Service, Fort Collins, CO.
C. A. Troendle.
IN: Forest Hydrology and Watershed Management. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication No. 167, 1987. p 545-552, 3 fig, 3 tab, 9 ref.

Descriptors: *Forest hydrology, *Rainfall-runoff relationships, *Clear-cutting, *Forest watersheds, *Streamflow, *Forest management, Monitoring, Surface flow, Storm seepage, Flood peak, Lateral flow.

The flow producing mechanisms on two forested plots (17 x 210 m and 36 x 210 m) were monitored for 7 yrs. Surface, shallow subsurface (0-1 m), and deep subsurface (1-4 m) lateral flows were intercepted and measured, as were the fluctuation of perched water tables and soil moisture content on the two hillslopes. After the fifth season, one plot was clearcut. Peak water equivalent in the snowpack, total flow, and peak discharge rate increased during the first full yr following harvest. The timing of the peak was not affected. Observations of water movement on both study plots appears to define the streamflow generating processes representative of the subalpine environment. (See also W90-01432) (Author's abstract)
W90-01483

**SIMULATION OF EFFECTS OF FOREST GROWTH ON WATER YIELD WITH A DYNAMIC PROCESS-BASED USER MODEL.**
Natal Univ., Pietermaritzburg (South Africa). Dept. of Agricultural Engineering.
R. E. Schulze, and W. J. George.
IN: Forest Hydrology and Watershed Management. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication No. 167, 1987. p 575-584, 6 fig, 1 tab, 6 ref.

Descriptors: *Forest watersheds, *Model studies, *Forest hydrology, *Water yield, *Rainfall-runoff relationships, *Hydrologic models, *Reforestation, Land use, Litter, Root zone, Growth rates, Forest management.

The effects of afforestation on water yield are reviewed. In the light of research findings and the method currently used in South Africa to determine reductions of water production with afforestation, the ACRU model is adapted to account for changes in important land-use-related processes as a forest grows in time, by incorporation of a dynamic land use information file. Tests with this model on a basin at Cathedral Peak in Natal, afforested in 1951, indicated that forest hydrological effects can be modelled successfully with a dynamic land use file. Further model testing and refinement is being undertaken to include, inter alia, processes such as litter interception, improved root extraction patterns, effects of different tree species, growth rates, management practices and climatic regimes in order to extend the application of this model to cover a wide range of forested environments. Since few basins are entirely forested, a distributed model version of ACRU has been developed to account for land use and soil heterogeneity within basins. (See also W90-01432) (Author's abstract)
W90-01486

**INFLUENCE OF CLIMATE CHANGE AND CLIMATIC VARIABILITY ON THE HYDROLOGIC REGIME AND WATER RESOURCES.**
For primary bibliographic entry see Field 2A.
W90-01537

**RAINFALL TRENDS IN WEST AFRICA, 1901-1985.**
Lagos Univ. (Nigeria). Dept. of Geography.
For primary bibliographic entry see Field 2B.
W90-01541

**IMPACTS OF CO2-INDUCED CLIMATE CHANGE ON HYDRO-ELECTRIC GENERATION POTENTIAL IN THE JAMES BAY TERRITORY OF QUEBEC.**
Montreal Univ. (Quebec).
B. Singh.
IN: The Influence of Climate Change and Climatic Variability on the Hydrologic Regime and Water Resources, International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication No. 168, 1987. p 403-418, 2 fig, 11 tab, 19 ref.

Descriptors: *Greenhouse effect, *Climatology, *Global warming, *Hydroelectric power, *Quebec, Model studies, Carbon dioxide, Economic aspects.

The impact of CO2-induced climatic changes on the hydroelectricity generating capacity of three basins within the James Bay Territory in Quebec have been evaluated. The hydro-generating capacity of the three basins were derived from actual and projected changes which were then used to gage the potential economic costs or benefits of CO2-induced climate changes. Increases on the order of 6.7 to 20.2 percent were projected based on the GFDL and GISS models. This increase in net basin supply should increase the hydrogenerating potentials of these drainage basins by about 9.2 TW/h to 9.5 TW/h. These increased generating potentials should provide important economic advantages for the province of Quebec, since hydroelectricity, being a relatively cheap energy form, would replace the other more conventional and costly forms of energy such as coal and oil. (See also W90-01537) (White-Reimer-PTT)
W90-01572

**CLIMATE CHANGE AND WATER RESOURCES.**
World Meteorological Organization, Geneva (Switzerland).
A. J. Askew.
IN: The Influence of Climate Change and Climatic Variability on the Hydrologic Regime and Water Resources, International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication No. 168, 1987. p 421-430, 12 ref.

Descriptors: *Global warming, *Climatology, *Water resources development, Climates, Hydrology, Future planning, Projections.

The consideration of the impact of climate on water resources is placed in a wider context: the chain reaction associated with such an impact crosses the interfaces between climate, hydrology, water-resource systems and society. Each interface demands collaboration and exchange of information between specialists and assurance that current tools and approaches are appropriate for the new environment that may evolve. The chain reaction must be studied from start to finish if the final impact on water resources is to be assessed. Various points are presented for consideration at each stage. (See also W90-01537) (Author's abstract)

W90-01573

**METHODOLOGY FOR DISTINGUISHING BETWEEN THE EFFECTS OF HUMAN INFLUENCE AND CLIMATE VARIABILITY ON THE HYDROLOGIC CYCLE.**
Dansk Hydraulisk Inst., Hoersholm.
J. C. Refsgaard.
IN: The Influence of Climate Change and Climatic Variability on the Hydrologic Regime and Water Resources, International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication No. 168, 1987. p 557-570, 6 fig, 19 ref.

Descriptors: *Environmental impact, *Global warming, *Greenhouse effect, *Climatology, *Hydrologic models, *Hydrologic cycle, Watershed management, Topography, Geology, Soil, Vegetation, Anthropogenic effects, Streamflow, Groundwater, Model studies, History.

The hydrologic cycle is influenced both by the climate and by the catchment characteristics such as topography, geology, soil, vegetation, water development etc. A methodology is presented for distinguishing between the effects of man's influence and climate variability on the hydrologic cycle, in particular streamflow and groundwater. The methodology is based on the application of deterministic hydrologic models. It is illustrated in two case studies in which a lumped, conceptual and distributed, physically based model, respectively, are applied to predict the effect of climate variability (sequences of development) on the aquifer piezometric heads and streamflows. It was determined that lumped, conceptual models are applicable for detecting historical hydrologic changes and for predicting the efects of minor climate changes. The distributed, physically based models are applicable both for detection and for prediction of future changes due to climate change as well as human activity. (See also W90-01537) (Author's abstract)
W90-01584

**HYDROLOGICAL PROCESSES AND WATER MANAGEMENT IN URBAN AREAS.**
For primary bibliographic entry see Field 2A.
W90-01612

**HYDROLOGICAL BALANCE CHANGES IN URBANIZED TERRITORY.**
Slovenska Akademia Vied, Bratislava (Czechoslovakia). Ustav Hydrologie a Hydrauliky.
J. Benetin, A. Soltesz, and J. Marton.
IN: Hydrological Processes and Water Management in Urban Areas. Proceedings of the International Symposium 24-29 April 1988, Duisburg, West Germany. International Hydrological Programme of UNESCO Publication, 1988. p 23-28, 1 fig, 3 tab, 3 ref.

Descriptors: *Hydrologic budget, *Rainfall-runoff relationships, *Urban areas, *Evapotranspiration, *Urban hydrology, Groundwater budget, Permeability.

With the development of industry and economic, cultural and political life, the actual built-up area of Bratislava, Czechoslovakia has extended from 39.25 sq km to 292.1 sq km, between the years 1945 and 1985. At the same time, the number of inhabitants increased from 121,000 to about 417,000. Daily water consumption (at 186.4 L/d) was 22.563 cu m in 1945. Today, the mean daily supply of drinking water is 255,247 cu m. To evaluate the change in water balance from 1945 to 1985, it was necessary to determine the relative abundance of areas with the same hydrological properties for the 30 separate divisions of the Bratislava area. For each division, the relative abundance of each of the following, was determined: (1) stabilized surface (covered constructions, roads, yards, parking places, stabilized playgrounds, etc.); (2) unstabilized soil surface (parks, gardens, lawns, etc.); (3) fields; and (4) water areas. For each of these areas the water balance components (monthly precipitation totals, monthly infiltration totals, monthly evapotranspiration totals, and monthly runoff totals) were calculated. In urbanized territory, the rain water runoff is substantially increased due to the great extension of areas with stabilized, impermeable surfaces. At the same time evaporation (evapotranspiration) decreases to a greater extent than the increase in runoff. This greater decrease in evaporation compared with the increase in runoff, is due to the decrease of winter moisture and groundwater storage in the urban watershed. (See also W90-01612)(Lantz-PTT)
W90-01614

**CONCERNING THE EXPERIMENTAL MEASUREMENTS OF INFILTRATION FOR THE RUNOFF MODELISATION OF THE URBAN WATERSHEDS IN WESTERN AFRICA.**
Office de la Recherche Scientifique et Technique Outre-Mer, Montpellier (France).
For primary bibliographic entry see Field 7A.
W90-01615

**URBAN WATER BALANCE IN THE RHENISH LIGNITE AREA.**
D. Briechle.
IN: Hydrological Processes and Water Management in Urban Areas. Proceedings of the International Symposium 24-29 April 1988, Duisburg, West Germany. International Hydrological Programme of UNESCO Publication, 1988. p 37-44, 3 fig.

Descriptors: *Urban hydrology, *Urban watersheds, *Hydrologic budget, *Water demand, Water use, Water resources management, Groundwater level, Rhine River.

With about 600 inhabitants/sq km, the area between Cologne, Aachen and Dusseldorf is one of the most strongly urbanized areas in the Federal Republic of Germany. Extensive dewatering measures aimed at keeping the open brown coal pits in that area dry, are of particular importance for the water conditions of the areas. This requires a lowering of the groundwater level of up to 500 m, achieved through 1000 vertical well points reaching depths of up to 500 m and covering individual or several aquifers. Some wells have a capacity of 30 cu m/min. In the Rhenish area the annual mean precipitation is 600 to 750 mm. The evaporation rate is 450 to 500 mm/a so that 150 to 250 mm/a remain as runoff. Between 20% and 95% of this runoff infiltrates to the groundwater. Total water demand in the Rhenish area is 441.1 million cu m/a. Thirty-three percent of this water is used as cooling water for the brown coal power plants, another 34% is used by industry and trade, 28% for public water supply, 4% is used by the mining industry itself, while the remaining 1% covers agricultural, domestic and similar demands. Although at present enormous volumes of water are pumped out of the soil of the Rhenish lignite area, they cannot be included in the balance of 'debit and credit' since they originate mainly from groundwater resources which may not be managed on a long-term basis, since they do not regenerate and are available only once. It would be irresponsible to establish with this non-recurrent sump water supply structures designed for a long period. The use of these resources must be limited to activities directly depending on the mining industry, for instance, the cooling of power plants based on brown coal or coal-processing industrial plants. Groundwater resources should, moreover, be used in sectors which must be saved beyond the time of influence through the mining industry. In spite of the immense influence of the sinking of the groundwater level due to the lignite mining industry on the largely urbanized environment in the Rhenish area, which will be detectable even centuries from now, it can never-the-less be proved by means of a voluminous data base, that even in the future, there will be no water shortage in this area. (See also W90-01612) (Lantz-PTT)
W90-01616

**USE OF REGRESSION TECHNIQUES TO ESTIMATE OVERFLOW FREQUENCIES FROM DAILY PRECIPITATION DATA.**
Royal Netherlands Meteorological Inst., De Bilt.
For primary bibliographic entry see Field 5D.
W90-01617

**ASPECTS OF URBAN HYDROLOGY IN DEVELOPING COUNTRIES: A CASE STUDY OF ADDIS ABABA.**
Addis Ababa Univ. (Ethiopia). Faculty of Technology.
IN: Hydrological Processes and Water Management in Urban Areas. Proceedings of the International Symposium 24-29 April 1988, Duisburg, West Germany. International Hydrological Programme of UNESCO Publication, 1988. p 53-60, 10 fig, 8 ref.

Descriptors: *Urban hydrology, *Addis Ababa, *Developing countries, *Rainfall-runoff relationships, Case studies, Hydrometeorology, Water resources development, Drainage systems, Flood control, Urban drainage.

Urban hydrology in developing countries may be considered to be a marginal problem, since the design of necessary storm sewers seems to be less important than the provision of drinking water, and reservoirs for irrigation and hydropower generation. However, increasing industrialization and concentration of people in urban centers will lead to the implementation of protective measures against flood flow caused by improper natural and artificial drainage systems. This paper discusses the hydrological and watershed management problems of Addis Ababa, where plans for improving the existing but limited storm drainage system are already available. Storm drainage and flood protection measures are necessary, and should follow an integrated approach comprising classical storm sewers in areas of high economic value and training of the natural drains, with appropriate measures including catchment stabilization in the upper reaches. The lower reaches of the rivers need training measures to stabilize the endangered embankments and to discharge the increasing runoff from the inhabited areas, which is caused by improving road conditions with asphalting and construction of sidedrains. Technical measures should be limited to the construction of flood protection and training walls in densely inhabited areas, while in some reaches, the river courses could be developed into small recreational areas using tree and bush plantings for embankment stabilization. All measures could be implemented by local laborers with local materials; foreign expertise is not needed. (See also W90-01612) (Lantz-PTT)
W90-01618

**GROUNDWATER RECHARGE IN URBAN AREAS.**
Birmingham Univ. (England). Dept. of Geological Sciences.
For primary bibliographic entry see Field 2F.
W90-01620

**STOCHASTIC ANALYSIS OF RAINFALL FOR URBAN DRAINAGE STUDIES.**
McGill Univ., Montreal (Quebec).
For primary bibliographic entry see Field 2A.
W90-01621

**DETAILED WATER BUDGET FOR THE CITY OF LUND AS A BASIS FOR THE SIMULATION OF DIFFERENT FUTURE SCENARIOS.**
Lund Univ. (Sweden). Dept. of Water Resources Engineering.
For primary bibliographic entry see Field 6A.
W90-01622

**RECENT TRENDS IN PRECIPITATION AND THE WATER BALANCE OF TROPICAL CITIES: THE EXAMPLE OF LAGOS, NIGERIA.**
Lagos Univ. (Nigeria). Dept. of Geography.
For primary bibliographic entry see Field 2A.
W90-01623

**EVAPOTRANSPIRATION FROM URBAN AREAS.**

British Columbia Univ., Vancouver. Dept. of Geography.
For primary bibliographic entry see Field 2D.
W90-01624

**INTERACTION OF FLOOD WATER FLOWS IN SEWER NETWORKS AND SMALL RIVER SYSTEMS.**
Ingenieurbuero fuer Conrath und Partner, Spiesen-Elversberg (Germany, F.R.).
For primary bibliographic entry see Field 2A.
W90-01625

**WATER BALANCE TECHNIQUES APPLIED TO INDUSTRIAL COMPLEXES.**
Laboratorium voor Grondmechanica, Delft (Netherlands).
For primary bibliographic entry see Field 2A.
W90-01626

**GROUNDWATER RESPONSE IN THE URBAN SECTORS OF CAIRO ENVIRONS, EGYPT.**
Qatar Univ., Doha. Dept. of Geology.
E. A. Korany, and M. E. Abdel Aal.
IN: Hydrological Processes and Water Management in Urban Areas. Proceedings of the International Symposium 24-29 April 1988, Duisburg, West Germany. International Hydrological Programme of UNESCO Publication, 1988. p 429-436, 3 fig, 1 tab, 12 ref.

Descriptors: *Urban hydrology, *Urban areas, *Cairo, *Groundwater quality, Egypt, Aquifers, Groundwater movement, Urbanization, Nile River.

The groundwater regime in the Pleistocene aquifer in urban sectors of Cairo is highly affected by modern activities--specifically with respect to the urbanization plan during the past few years. It is approved by studying the prevailing conditions, the monthly fluctuation of the water table for the average year, and the interpreted flow patterns. It became clear that the flow systems of the Nile River and its groundwater resources, are changed in several ways. The water table is steadily rising. The natural conditions, and factors induced by man, are responsible for the development of the new situation. (See also W90-01612) (Author's abstract)
W90-01660

**QUANTITY AND QUALITY OF GROUNDWATER BENEATH AN INDUSTRIAL CONURBATION--BIRMINGHAM, UK.**
Birmingham Univ. (England). Dept. of Geological Sciences.
For primary bibliographic entry see Field 2F.
W90-01662

**INFLUENCE OF URBANIZATION ON THE QUALITY OF GROUNDWATER.**
Slovenska Vysoka Skola Technicka, Bratislava (Czechoslovakia).
J. Marton, and I. Mohler.
IN: Hydrological Processes and Water Management in Urban Areas. Proceedings of the International Symposium 24-29 April 1988, Duisburg, West Germany. International Hydrological Programme of UNESCO Publication, 1988. p 453-460, 3 ref.

Descriptors: *Czechoslovakia, *Urbanization, *Groundwater quality, *Water resources development, Dams, Danube River, Bratislava, Water demand, Water use, Urban drainage, Industrial pollution.

In Bratislava, Czechoslovakia, the original, natural regime of groundwater has recently been influenced by anthropogeneous activity, including: (1) the construction of a flood dam and seal along the right bank of the Danube; (2) technological interferences (discharges) into the river basin of the Danube; (3) gravel dredging; (4) legal and illegal consumption of water for water supply, industrial, agricultural and communal purposes; (5) construction activities including the construction of a drainage system, water system, pilot foundations, underground and other constructions; and (6) pollution of the river region by organic substances from chemical and refinery industries and uncontrollable waste-tips of industrial waste. (See also W90-01612) (Lantz-PTT)
W90-01663

**EFFECT OF URBANIZATION ON A SHALLOW QUATERNARY AQUIFER.**
Technische Univ. Muenchen (Germany, F.R.). Lehrstuhl fuer Hydrogeologie und Hydrochemie.
B. Merkel, J. Grossman, and P. Udluft.
IN: Hydrological Processes and Water Management in Urban Areas. Proceedings of the International Symposium 24-29 April 1988, Duisburg, West Germany. International Hydrological Programme of UNESCO Publication, 1988. p 461-468, 2 fig, 4 tab, 3 ref.

Descriptors: *Urbanization, *Groundwater quality, *Path of pollutants, *Groundwater pollution, Aquifers, Zinc, Cadmium, Heavy metals, Soil water, Urban areas, Water pollution sources, Fate of pollutants.

The quantity and quality of groundwater renewal is mainly determined by physico-chemical processes within the soil and the unsaturated zone. Pollution of groundwater from urbanization was brought to light by deposits from precipitation, sodium chloride, infiltration, and leakage from sewage. In Munich, the dry and wet deposits exceed the input from weathering significantly. The content of copper and lead in urban rain water varies within the magnitude of equilibrium conditions, while cadmium and zinc concentrations are far from saturation. Looking at the zinc concentrations, it is obvious that the content in depth of 20 cm is higher than in rain water. This is linked to dry zinc deposits and solution in the soil water. The soil water in depths of 20 cm is far from being saturated with respect to all heavy metals investigated. This points out, that the immobilization of heavy metal ions in the unsaturated zone is mostly not controlled by the solubility products but cation exchange and sorption effects. The heavy metal concentrations in groundwater exceed the contents related to weathering processes with the exception of lead, due to global heavy metal pollution. However, there was no significant increase found within the urban groundwater region. (See also W90-01612) (Lantz-PTT)
W90-01664

**EFFECT OF URBANIZATION ON THE HYDROLOGICAL SYSTEM AND WATER QUALITY.**
Warsaw Univ. (Poland).
Z. Mikulski.
IN: Hydrological Processes and Water Management in Urban Areas. Proceedings of the International Symposium 24-29 April 1988, Duisburg, West Germany. International Hydrological Programme of UNESCO Publication, 1988. p 469-477.

Descriptors: *Water pollution sources, *Urban hydrology, *Urbanization, *Urban drainage, *Management planning, Information exchange, Water quality, Sewers, Research priorities.

The problem of the effect of urbanization on water relations has recently come to be the subject of international cooperation. In 1970, a working group of the International Hydrological Decade (IHD) undertook the assessment of the knowledge of the problem in the world. The replacement of the IHD by the UNESCO Hydrological Program gave rise to a separate Project MPS-1/7 'The Effect of the Urbanization on the Hydrological System and Quality of Water.' The project embraced a wide range of problems of the effect of urbanization on water resources, including collection of data and their analysis, application of mathematical models in urban hydrology, socio-economic aspects and impact of urbanization on water planning and management. In the years 1977, 1978, 1981 three volumes entitled 'Studies in Urban Hydrology' were published which included reports on the contemporary knowledge of these problems and were based on the information of the selected countries. At the second stage of the IHP (1981-1983) the analysis of the effect of urbanization was continued within the framework of the sub-project A.2.9 'Dissemination of the Information on Hydrological Processes in Urban Areas'. A technical guide was compiled on the data on precipitation as well as schemes of the drainage systems of urban areas and a manual concerning the gathering and analysis of data on urban hydrology. In addition, a popular leaflet entitled 'Water and the City' was published. The third stage of the IHP (1984-1989) includes the project 0.3 'The Summing up of the Information on Hydrological Processes in Urban Areas and the Effect of Urbanization on the Hydrological Cycle'. The project comprises: (1) translation of the leaflet 'Water and the City' into other languages as well as manuals concerning the designing of the sewage system; (2) organization of the seminars on hydrological processes in urban areas; (3) organization of regional courses on the designing of the sewage system; and (4) working out of the country research programs on urban hydrology (permanent country research and publications). The fourth stage of cooperation (until 1988) envisages research on prospects, particularly experimental studies and the conception of mathematical models of the effect of urbanization on the hydrological system and water quality. (See also W90-01612) (Lantz-PTT)
W90-01665

**EFFECTS OF URBAN SOIL SEALING AND SOIL MODIFICATION ON THE GROUND- AND SOIL-WATER BUDGET AND THEIR MANAGEMENT BY PLANNING.**
Geologisches Landesamt Hamburg (Germany, F.R.).
A. Paluska, J. Pietsch, L. R. Berlekamp, and N. Pranzas.
IN: Hydrological Processes and Water Management in Urban Areas. Proceedings of the International Symposium 24-29 April 1988, Duisburg, West Germany. International Hydrological Programme of UNESCO Publication, 1988. p 479-486, 1 tab, 6 ref.

Descriptors: *Soil water, *Infiltration, *Urban hydrology, *Surface sealing, *Hydrologic budget, *Urban planning, Management planning, Groundwater quality, Urbanization.

The negative effects of soil sealing and soil modification on the urban ecosystem confronts the city planners with increasing problems. At present, the problem of urban soil sealing and soil modification and its management by planning is investigated in an interdisciplinary research project which is supported by the Federal Ministry for Research and Technology. These processes create problems with the natural functions of soil. The dominant planning target for the future is a well considered, well balanced and efficient use of soil sealing and their accompanying phenomena. The following aspects are highly relevant: the quality of water which is suitable for an infiltration; the capacity of the building ground or natural materials suitable for infiltration; frame conditions determined by the existing buildings; contamination of the infiltrates by components from anthropogenic layers; and reaction of the perched groundwater table on an artificial infiltration. The complexity of these tasks confronts the city planners with problems which can be only solved by a progress in scientific research. For this purpose, an interdisciplinary research project has been established, to be conducted over the next three years. The most important innovative beginnings of this project, which started in 1987, are explained in this paper. (See also W90-01612) (Lantz-PTT)
W90-01666

**IMPACT OF AN URBAN AREA ON THE HYDROCHEMISTRY OF A SHALLOW GROUNDWATER (ALLUVIAL RESERVOIR) TOWN OF NARBONNE, FRANCE.**
Montpellier-2 Univ. (France). Lab. d'Hydrogeologie.
M. Razack, C. Drogue, and M. Baitelem.
IN: Hydrological Processes and Water Management in Urban Areas. Proceedings of the Interna-

tional Symposium 24-29 April 1988, Duisburg, West Germany. International Hydrological Programme of UNESCO Publication, 1988. p 487-494, 5 fig, 4 tab, 4 ref.

Descriptors: *Urbanization, *Groundwater quality, *Narbonne, *Groundwater pollution, *France, Geochemistry, Chemical analysis, Sulfates, Nitrates, Sodium, Chlorides.

The Romans founded the urban area of Narbonne in Southern France, which is built on a shallow alluvial reservoir. This reservoir, with thicknesses ranging from 10 to 30 meters, is composed of various compacted materials and quaternary deposits. A hydrochemical survey carried out during the Summer of 1984 and the Winter of 1985 showed an important impact of urban activity on groundwater quality. This impact is expressed through the superimposition, beneath the city, of a variety of exogenous element issued from urban activity (SO4, NO3) and natural chemistry (Na, Cl). It was found that these sulfates and nitrates would provoke a permanent contamination of the shallow groundwater. (See also W90-01612) (Lantz-PTT)
W90-01667

**AGGRAVATION OF FLOOD CONDITIONS DUE TO INCREASED INDUSTRIALIZATION AND URBANIZATION.**
Eidgenoessische Technische Hochschule, Zurich (Switzerland).
K. G. Richter, and G. A. Schultz.
IN: Hydrological Processes and Water Management in Urban Areas. Proceedings of the International Symposium 24-29 April 1988, Duisburg, West Germany. International Hydrological Programme of UNESCO Publication, 1988. p 495-503, 6 fig, 7 ref.

Descriptors: *Urban runoff, *Urbanization, *Flood plains, *Industrial development, *Rainfall-runoff relationships, Land use, Flood peak, Mathematical models, Hydrologic models, Case studies, West Germany, Infiltration rate.

Qualitatively it is known that man's activities, such as urbanization and industrialization, have a significant impact on hydrologic conditions in river basins. Particularly, floods are aggravated by an increase of flood peaks and a reduction of time to peak. For planning purposes it is often necessary to quantify the change in flood conditions on the basis of the planned change in land use. Three deterministic mathematical rainfall-runoff models were analyzed according to their capability to simulate such changing conditions. It was found that a distributed system models was superior to two well known lumped system models. This paper discusses the application of this model in three different test catchments in the upper Emscher region in West Germany. The model which subdivides the catchment area into small area elements by superimposing a grid system, is characterized by calculating translation and storage attenuation effects in two consecutive steps. Each elemental area is characterized by its specification of land use, different infiltration rate, and flow velocities. The specification of different types of land use is accomplished with the aid of a Geographic Information System using LANDSAT Thermatic Mapper satellite data. Results of the model application are presented, one of which is the fact that the distributed system model is able to quantify the expected changes of flood conditions depending on where within the catchment new developments are planned. (See also W90-01612) (Author's abstract)
W90-01668

**IMPACTS OF URBANIZATION OF THE GREATER CAIRO AREA ON THE GROUND WATER IN THE UNDERLYING AQUIFER.**
International Inst. for Hydraulic and Environmental Engineering, Delft (Netherlands).
M. M. A. Shahin.
IN: Hydrological Processes and Water Management in Urban Areas. Proceedings of the International Symposium 24-29 April 1988, Duisburg, West Germany. International Hydrological Programme of UNESCO Publication, 1988. p 517-524, 3 fig, 1 tab, 5 ref.

Descriptors: *Water pollution sources, *Urbanization, *Cairo, *Groundwater quality, *Aquifers, Groundwater budget, Water supply, Nile River, Sewers, Water conveyance, Leakage, Sulfates, Water demand.

Cairo, like many capital cities in developing countries, is expanding in urbanization because of its growing population. The consumption of water is increasing with time and with urbanization. The demand is supplied partly from the Nile and partly from the aquifer underlying the Greater Cairo area. Only a small part of the township is served by an old municipal sewage system. At present, the sewers are running full and under pressure. The leakage from the water supply and sewage pipes accumulates in the low spots and turns them into wastewater pools. It also causes the contamination of the groundwater. The increasing sulfate content is a menace to the concrete foundations of buildings. Improvement and expansion of the water supply and sewage networks are underway. However, it will take a long time before these works are completed. By the year 2000, the demand will reach more than double its present figure. Unless effective measures are taken to keep the population growth under control, the future might not be any better than the present. (See also W90-01612) (Author's abstract)
W90-01670

**GROUNDWATER AND SURFACE WATER QUALITY IN AND AROUND BHOPAL CITY IN INDIA.**
Central Ground Water Board, Bhopal (India).
V. P. Sharma.
IN: Hydrological Processes and Water Management in Urban Areas. Proceedings of the International Symposium 24-29 April 1988, Duisburg, West Germany. International Hydrological Programme of UNESCO Publication, 1988. p 525-532, 1 fig, 1 tab.

Descriptors: *Water resources development, *Groundwater resources, *Groundwater quality, *Surface water, *Bhopal, *Groundwater budget, Groundwater management, India, Chemical analysis, Water resources development.

The existing water supply facility for Bhopal, India is limited; the so-called Upper lake constitutes the main source of water supply. A few tube wells are supplementing this supply. The population of the city is growing very fast, and city managers are looking for alternative sources, mainly surface waters, as the groundwater resources are seemingly limited. A special hydrochemical study consisting of 60 water samples, from groundwater and surface water, was carried out and the results examined qualitatively. The findings indicate good water quality, and it is recommended that these resources be suitably harnessed by the city planners in order to meet future requirements of water for the city. (See also W90-01612) (Author's abstract)
W90-01671

**HYDROGEOLOGICAL STUDIES WITHIN THE FRAMEWORK OF AN ECOLOGICAL RISK ANALYSIS OF HARBOUR MUD DEPOSITS.**
Arbeitsgemeinschaft Hydrogeologie und Umweltschutz, Aachen (Germany, F.R.).
H. Stolpe, and G. Bruss.
IN: Hydrological Processes and Water Management in Urban Areas. Proceedings of the International Symposium 24-29 April 1988, Duisburg, West Germany. International Hydrological Programme of UNESCO Publication, 1988. p 543-552, 5 fig, 2 ref.

Descriptors: *Geohydrology, *Urbanization, *Groundwater quality, Simulation analysis, Hydrologic models, Model studies, Groundwater movement, Groundwater pollution.

Interdisciplinary ecological risk studies are being more frequently carried out to minimize the harmful effects of big construction enterprises. In this context, the aspect of groundwater protection is often of particular importance. The cleanup of a mud deposit in Hamburg is given as an example of a groundwater study integrated into an ecological study. Within this study area, there is a growing conflict between groundwater exploitation and waste management. A comprehensive inventory and evaluation of geohydrological and groundwater quality data was made to investigate the complex system in this area. This evaluation provided the foundation for a groundwater model. With the aid of the model, it was possible to simulate potential consequences of groundwater withdrawal and deposit planning. Time of travel and direction of groundwater flow were regarded the critical parameters for the evaluation of different planning variants. The results led to the choice of a planning variant which promises a minimal groundwater contamination. (See also W90-01612) (Author's abstract)
W90-01673

**EFFECTS OF URBANIZATION ON WATER RESOURCES IN THE WATERFORD RIVER BASIN.**
Newfoundland Dept. of the Environment, St. John's.
W. Ullah, J. Marsalek, T. Hennigar, and T. L. Pollock.
IN: Hydrological Processes and Water Management in Urban Areas. Proceedings of the International Symposium 24-29 April 1988, Duisburg, West Germany. International Hydrological Programme of UNESCO Publication, 1988. p 553-560, 8 ref.

Descriptors: *Urbanization, *Water quality, Waterford River, Runoff, Flood peak, Urban hydrology, Bacteria, Water quality control, Groundwater quality, Sodium chloride.

The continuing urbanization of the Waterford River Basin, England will not significantly increase the volume of runoff, but will increase the peak flows by about 25%. Although urban development has increased pollution in the river during the early stages of runoff, the only real concern has been caused by high bacteria counts preventing body contact recreation in the river. Runoff quantity and quality in fully urbanized sewered catchments have been effectively controlled by maintaining low effective imperviousness and low density of sewer inlets. Groundwater in the basin has been barely affected by progressing urbanization except for elevated levels of sodium chloride originating from road salting operations. (See also W90-01612) (Author's abstract)
W90-01674

**URBAN WATER QUALITY IN RELATION TO COMBINED SEWER OVERFLOW AND STORMWATER RUN-OFF IN AMSTEL- EN GOOILAND.**
Amstel- en Gooiland Water Pollution Control Authority, Hilversum (Netherlands).
P. J. T. Verstraelen, Y. Scheffer-Ligtermost, R. B. Koeleman, and J. C. A. Van Alphen.
IN: Hydrological Processes and Water Management in Urban Areas. Proceedings of the International Symposium 24-29 April 1988, Duisburg, West Germany. International Hydrological Programme of UNESCO Publication, 1988. p 561-569, 1 fig, 2 tab, 7 ref.

Descriptors: *Urban runoff, *Combined sewer overflows, *Urban areas, *Water quality control, Urbanization, Storm water, Storm runoff, Dissolved oxygen, Ammonia, Suspended sediments.

Data are presented from a comparative survey of urban waters receiving combined sewer overflows or stormwater runoff. The results of this investigation show that combined sewer systems generally do not meet discharge limits inserted in permits. National water quality objectives are not met in waters receiving combined sewer discharges irrespectively of the system itself meeting the discharge limits or not. Problem parameters are dissolved oxygen, ammonia and toxic pollutants. Quality objectives are met in almost all waters

receiving stormwater runoff. Sediment data indicate that urban water pollution is not exclusively the result of wastewater discharges. (See also W90-01612) (Author's abstract)
W90-01675

**HYDROLOGICAL IMPACT OF URBANIZATION--A STUDY OF THE PALMIET RIVER IN METROPOLITAN DURBAN, SOUTH AFRICA.**
Durban-Westville Univ. (South Africa). Dept. of Geography.
G. T. De Villiers.
IN: Hydrological Processes and Water Management in Urban Areas. Proceedings of the International Symposium 24-29 April 1988, Duisburg, West Germany. International Hydrological Programme of UNESCO Publication, 1988. p 571-578, 2 tab, 8 ref.

Descriptors: *Urbanization, *South Africa, *Urban runoff, *Urban hydrology, Durban, Flood peak, Discharge frequency, River channels, Channel morphology, Sediment transport, Aluminum, Iron, Manganese, Calcium, Potassium, Phosphorus, Chlorides, Sodium, Hydrogen ion concentration, Conductivity, Nitrates, Ammonia, Phosphates, Alkalinity, Palmiet River.

Urbanization has had a drastic effect on the hydrology of the Palmiet River, Durban, South Africa. Peak discharge rates increased four-fold while discharge volumes increased by 15%. Channel morphology, dynamics and sediment transport were similarly influenced while the water quality also deteriorated downstream. The Pinetown Central Business District has a marked impact on the River. The analyte values (for pH, conductivity, Ca(2+), K(+), Mg(2+), Na(+), Cl(-), phosphates, nitrates, ammonia, Si, F(-), alkalinity, P, and total dissolved solids) in the Palmiet River are noticeably higher than those of the Umgeni River. Measured by world standards Al, Fe and Mn values are high throughout the year, while other analytes randomly exceed world norms. (See also W90-01612) (Author's abstract)
W90-01676

**GROUNDWATER POLLUTION BY TILBURG'S GAS PLANT.**
Iwaco B.V., Boxtel (Netherlands).
W. J. Van Vossen, and T. M. F. Huijsmans.
IN: Hydrological Processes and Water Management in Urban Areas. Proceedings of the International Symposium 24-29 April 1988, Duisburg, West Germany. International Hydrological Programme of UNESCO Publication, 1988. p 579-587, 3 fig, 5 ref.

Descriptors: *Groundwater pollution, *Industrial plants, *Fate of pollutants, *Path of pollutants, Tilburg, The Netherlands, Industrial water, Cyanide, Aromatic compounds, Phenols, Infiltration, Path of pollutants, Hydrologic models, Water density, Groundwater quality.

The town of Tilburg, in the south of The Netherlands, used to be the center of an extensive textile industry. Water for industrial purposes was obtained through local groundwater abstraction. For almost a century, a gas plant was operating in the center of the town, soil pollution by cyanides, aromatic compounds and phenols. Since rain water mainly infiltrates into the subsoil in the Tilburg area, pollution of the underlying aquifers and of the abstracted water was feared. An approach was selected consisting of a combination of hydrologic modeling and groundwater sampling to get an explanation for the pollution and its progression in time. The extent of the polluted area appears to have changed considerably with time. Calculations show extensive pollution in the 1930's and 1940's while most of this had disappeared by 1984, mainly due to groundwater abstraction. The calculated concentrations in 1984 showed a very close resemblance to the observed ones. The virtual nonexistence of pollution in 1984 was very surprising and would have been difficult to accept without the help of modeling. (See also W90-01612) (Author's abstract)
W90-01677

**IMPACTS ON GROUNDWATER QUALITY AND GROUNDWATER USE IN A HIGH POPULATED AND INDUSTRIALIZED URBAN REGION.**
Technologieberatung Grundwasser und Umwelt Koblenz, West Germany.
K. Zipfel, and U. Horalek.
IN: Hydrological Processes and Water Management in Urban Areas. Proceedings of the International Symposium 24-29 April 1988, Duisburg, West Germany. International Hydrological Programme of UNESCO Publication, 1988. p 607-616, 4 fig, 1 tab, 1 ref.

Descriptors: *Water pollution sources, *Groundwater quality, *Industrial development, *Urban hydrology, *Urbanization, *Management planning, Geohydrology, Groundwater pollution, Water pollution control.

A wide range of urban activities, especially uncontrolled waste disposal sites, have caused concern because of their potential to cause groundwater pollution in an urban region in the Upper Rhine valley. This paper presents a typical urban region in the Upper Rhine valley which has experienced industrial activity for the past 100 years. Steps to assess and evaluate the possible and existing influence of the multi-purpose land use in this and other areas on the groundwater resources are: (1) the systematic assessment of important information such as geohydrological and hydrological conditions, sites of storage or use of hazardous compounds, existing groundwater use, and the monitoring of groundwater quality and including its local and temporal changes; (2) the evaluation of transport conditions for contaminants in groundwater and determination of possible local and temporary restrictions of groundwater use; (3) additional investigations in selected areas having extensive contamination (including analysis of subsurface flow paths); (4) an assessment of the overall situation including identification of critical cases due to the results of the previous investigation steps; and (5) suggestions for necessary measures for groundwater protection and suggestions for restoration of contaminated sites. How these steps can be applied to specific regions where groundwater pollution from urban development is occurring, is the focus of this paper. (See also W90-01612) (Lantz-PTT)
W90-01680

**CHEMICAL AND BIOLOGICAL IMPACT OF COMBINED SEWER OVERFLOWS UPON A WATER REGULATION DITCH TYPICAL FOR URBANIZED AREAS IN THE NETHERLANDS.**
Rijksinstituut voor de Volksgezondheid en Milieuhygiene, Bilthoven (Netherlands).
D. de Zwart, and R. Luttik.
IN: Hydrological Processes and Water Management in Urban Areas. Proceedings of the International Symposium 24-29 April 1988, Duisburg, West Germany. International Hydrological Programme of UNESCO Publication, 1988. p 617-624, 4 fig, 1 tab.

Descriptors: *Water pollution sources, *Combined sewer overflows, *Ditches, *Urban drainage, *Water quality, Rhine River, The Netherlands, Biological studies, Biochemical oxygen demand, Ammonia, Bacteria, Coliforms.

In The Netherlands, the criteria for the design of sewer systems used to be solely based on hydrological consideration. It was accepted that heavy rainfall caused an overflow of the mainly combined sewer systems into receiving water bodies (CSO-events). From the viewpoint of quality management of surface waters, there was a need to include considerations of environmental impact in the renovation or new design of sewer systems. This paper present some of the results of a study covering the chemical and biological effects of seven CSO-events on a system of ditches which is continuously flushed with water from the Rhine River. The main objective of the study was to provide a data base for the selection of the most informative effect parameters to be measured in a survey of CSO locations. As a consequence, a broad spectrum of parameters was frequently analyzed, both in CSO and surface water (and sediments) including: classical water chemistry (ion composition, conductivity, COD, etc.); nutrients (P, N and Si); micropollutants (heavy metals, oil and detergents); bacteriological parameters (E. coli, etc.); and hydrobiological parameters (species composition of algae, zooplankton, macrofauna, and vegetation). For non-reactive parameters (like conductivity) the restoration is solely the effect of flush-out by water of the Rhine River. For the more reactive parameters (nutrients, oxygen and micropollutants) showing an increase on CSO-events. The restoration of water background levels is speeded up by processes additional to flush-out. The data series demonstrated that sedimentation and biochemical oxidation are the processes involved. The oxidation of CSO introduced biochemical oxygen demand (BOD), adding to the overall removal of these compounds. The bacterial investigation showed that the CSO related fecal load of the receiving water is removed in approximately 3 days. All hydrological observations indicated that the adverse conditions imposed by CSO-events do not last long enough to impair biological integrity. (See also W90-01612) (Lantz-PTT)
W90-01681

**RUNNING WATERS IN URBANIZED AREAS.**
Landesamt fuer Wasser und Abfall Nordrhein-Westfalen, Duesseldorf (Germany, F.R.).
G. Friedrich.
IN: Hydrological Processes and Water Management in Urban Areas. Proceedings of the International Symposium 24-29 April 1988, Duisburg, West Germany. International Hydrological Programme of UNESCO Publication, 1988. p 649-656, 4 ref.

Descriptors: *Urbanization, *Running waters, *Urban hydrology, Ecosystems, Canals, Legislation, Standards, Lotic environment, Public policy.

Running waters in urbanized areas have been disintegrated from the environment and in many cases changed into an artificial part of the canal system. In order to reintegrate the running waters into the functional unit of towns or villages, some formal requirements must be met. These requirements are: clear federal and state legislation, with laws relating to water, landscape and buildings; concrete, binding guidelines and technical rules and instruction; education and training of persons responsible for waters; assignment of land and provision of funds; and promoting the understanding and cooperating of affected and favored citizens. Running waters fall into three zones of varying formation and with varying functions: (1) the aquatic zone; (2) the amphibious zone; and (3) the terrestrial zone. Discussions of these three zones is the focus of this paper. (See also W90-01612) (Lantz-PTT)
W90-01684

**BROOKS INSIDE THE CITY, EXAMPLE: CITY OF ZURICH.**
T. Herrmann.
IN: Hydrological Processes and Water Management in Urban Areas. Proceedings of the International Symposium 24-29 April 1988, Duisburg, West Germany. International Hydrological Programme of UNESCO Publication, 1988. p 667-674, 4 fig, 8 ref.

Descriptors: *Zurich, *Switzerland, *Streams, *Surface water, *Urbanization, Ecosystems, Parks, Public lands, Recreation.

Meadowbrooks, ditches and watercourses are generally small in number, but exist even in cities. They are non-renounceable characteristics of cities and landscapes. They aid in arranging and greening settled areas, and are ecologically very important for netting the scattered biotopes. People use these open, green brook courses as parks throughout a city. In these parks, people find untouched natural open spaces, where children play and people can relax, and where research can be conducted. (See also W90-01612) (Lantz-PTT)
W90-01686

**FLOOD PROTECTION PLANTS OF THE CITY OF WASSERBURG A. INN.**
Wasserwirtschaftsamt Rosenheim (Germany, F.R.).
W. Kraus.
IN: Hydrological Processes and Water Management in Urban Areas. Proceedings of the International Symposium 24-29 April 1988, Duisburg, West Germany. International Hydrological Programme of UNESCO Publication, 1988. p 675-681, 2 photos.

Descriptors: *West Germany, *Urbanization, *Water resources development, *Flood control, *Dikes, Dams, Embankments, Recreation, Social aspects.

The city of Wasserburg A.Inn, West Germany, was often damaged by floods, so a protection plant was to be constructed by the Wasserrwirtschaftsamt Rosenheim. The medieval town is under a preservation order, creating difficulties in the design and construction of the flood protection wall in front of the city. A team of watershed management engineers was engaged to create the solution to these architectural problems, cooperating with biologists and the City Council. The flood protection dike was built on a zoned earth dam which rose almost 3 m over the natural level of the riverbank. The slope of the dike varies from meter to meter. There are little hollows in the slope, horizontal areas and smooth hills. A footpath is going along the dike, but does not remain on one level. At several places along the footpath, benches are installed for walkers to rest. In other places, huge stone, monolithic litter from a local gravel pit, are arranged for children and young people to play on. The design of this dike integrates the structure into the social and recreational needs of the community. (See also W90-01612) (Lantz-PTT)
W90-01687

**WATER IN THE LANDSCAPE OF A TOWN USING THE EXAMPLE OF GDANSK AND THE GDANSK CONURBATION.**
Gdansk Technical Univ. (Poland). Dept. of Architecture.
For primary bibliographic entry see Field 3D.
W90-01690

**EMSCHER RIVER-- A MODEL OF INTEGRATED WATER MANAGEMENT IN AN URBANIZED AREA: PROBLEMS AND CHALLENGES.**
Emschergenossenschaft und Lippeverband, Essen (Germany, F.R.).
For primary bibliographic entry see Field 3D.
W90-01692

**WATER MANAGEMENT IN URBAN AREAS OF A DEVELOPING COUNTRY.**
Dar es Salaam Univ. (Tanzania). Dept. of Civil Engineering.
For primary bibliographic entry see Field 5F.
W90-01694

**IMPACT OF UNCONTROLLED URBAN STORM-WATER INFLOW ON THE OPERATION OF IRRIGATION MAIN CANAL SYSTEMS.**
Calgary Univ. (Alberta). Dept. of Civil Engineering.
D. H. Manz, and N. Ratnayake.
IN: Irrigation and Water Allocation. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication no. 169, 1987. p 15-25. 4 fig, 4 tab, 8 ref.

Descriptors: *Urban runoff, *Irrigation canals, *Canal design, *Simulation analysis, *Computer models, *Storm runoff, Urban areas, Model studies, Hydrographs, Irrigation requirements, Transition flow, Steady flow.

Irrigation canals flowing through urban centers may receive uncontrolled storm water. The benefits associated with the additional water may be more than offset by the additional costs of a more complex canal design and operation. The impact of storm water on irrigation canal operation is considered a function of inflow hydrograph characteristics, location of outfalls, and the physical and operational characteristics of the canal receiving the water, and the irrigation water demands placed on the system. This analysis was made with the Irrigation Conveyance System Simulation computer model which can handle all characteristics mentioned in steady and transient flow conditions. The model was used on three types of structures: positive-inflow; storm-water outflow; and drop-structure. Results of sensitivity analyses showed that the sum of an instantaneous storm-water inflow and the initial canal discharge may exceed the canal design capacity without exceeding the canal design discharge anywhere along its length. The rate of storm-water flow into an irrigation canal will determine the size of the resulting flood waves; the times at which the peak discharges occur, however, will remain largely unchanged. The greater the rate of storm-water inflow, the longer the time required to achieve steady state. For canals of similar length variation in location of storm-water inflow will affect the development and recession of flood waves within the canal. Canals of different length receiving similar storm-water inflows will develop different flow conditions (rate of change in depth and discharge) during the development and recession of flood waves. (See also W90-01828) (Geiger-PTT)
W90-01830

**STORMWATER MANAGEMENT ALTERNATIVES.**
For primary bibliographic entry see Field 5G.
W90-01919

## 4D. Watershed Protection

**RIVER BASIN MANAGEMENT AND PRIVATIZATION.**
For primary bibliographic entry see Field 4A.
W90-01087

**CATCHMENT AFFORESTATION AND WATER SUPPLY IN STRATHCLYDE REGION.**
Strathclyde Regional Council, Glasgow (Scotland). Water Dept.
For primary bibliographic entry see Field 4C.
W90-01097

**FOREST HYDROLOGY AND WATERSHED MANAGEMENT.**
Proceedings of an International Symposium held during the XIXth General Assembly of the International Union of Geodesy and Geophysics at Vancouver, British Columbia, Canada, 9-22 August 1987. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. 1987. IAHS Publication No. 167. Edited by R. H. Swanson, P. Y. Bernier, and P. D. Woodard.

Descriptors: *Forest hydrology, *Watershed management, *Forest watersheds, *Symposium.

The purpose of this symposium was: (1) to focus the attention of researchers on the unsolved problems of land managers; (2) to determine whether hydrological research provides suitable methods for land managers; and (3) to provide a source document for both researchers and managers. Watersheds have a finite capacity to retain and store precipitation. Watershed management can be thought of as the applied field of forest hydrology. The application of hydrologic principles for watershed management is not simple even if the land use seems to be simple. Regardless of land use, vegetation interacts with precipitation and soil moisture. At best, vegetation can be used to modulate watershed characteristics, to favor increased water yield, to reduce erosion and sediment loads, and to reduce the introduction of undesirable chemicals. At worst, a watershed can be reduced to a completely unproductive state with no favorable hydrologic properties. (See W90-01433 thru W90-01490) (Rubinstein-PTT)
W90-01432

**FROM THE PLOT TO THE WATERSHED: SCALE EFFECT IN THE AMAZONIAN FOREST ECOSYSTEM (DE LA PARCELLE AU PETIT BASSIN-VERSANT: EFFET D'ECHELLE DANS L'ECOSYSTEME FORESTIER AMAZONIEN).**
Office de la Recherche Scientifique et Technique Outre-Mer, Cayenne (French Guiana).
J. M. Fritsch, P. L. Dubreuil, and J. M. Sarrailh.
IN: Forest Hydrology and Watershed Management. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication No. 167, 1987. p 131-142, 5 fig, 2 tab, 7 ref. English Summary.

Descriptors: *Rainfall-runoff relationships, *Forest hydrology, *Surface runoff, *Rain forests, *Forest watersheds, *Model studies, Catchment areas, Tropical regions.

Comparisons are made between surface runoff on a plot (400 sq m), on elementary drainage basins (0.15 sq km) and on a small drainage basin (4.5 sq km), all three on weathered shales and under tropical rain forest. Annual runoff on the plot was 8.8% of total rainfall in 1981, while small basin quickflow was 23%. The difference appears to result from soil properties. Elementary basin yield may be close to that of the plot or the small basin, depending on the evolution stage of pedologic cover. The variable source area concept is applicable in this region, for understanding scale effects. (See also W90-01432) (Author's abstract)
W90-01444

**METHOD FOR PREDICTING TERRAIN SUSCEPTIBLE TO LANDSLIDES FOLLOWING FOREST HARVESTING: A CASE STUDY FROM THE SOUTHERN COAST MOUNTAINS OF BRITISH COLUMBIA.**
Ministry of Environment and Parks, Victoria (British Columbia).
D. E. Howes.
IN: Forest Hydrology and Watershed Management. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication No. 167, 1987. p 143-154, 5 fig, 2 tab, 21 ref.

Descriptors: *Forest management, *Forest hydrology, *Landslides, *Logging, Mapping, Canada.

The terrain evaluation method for predicting post-logging landslide activity is based on the analysis of base data obtained from a landslide inventory and a terrain (surficial geology) mapping program. More objective and quantitative than previous approaches used in British Columbia, it involves four steps: (1) defining homogeneous areas, terrain polygons, with respect to their surficial geology; (2) analysis of landslide site data to identify factors influencing clearcut landslides; (3) defining a set of terrain classes based on these factors such that each polygon can be assigned to only one class; and (4) grouping the classes into four stability ratings based on the ratio of the number of clearcut landslides to the number of clearcut hectares. The results of a case study presented include a computer generated landslide rating map and a comparison of landslide rates to documented changes in local precipitation records since 1940. (See also W90-01432) (Author's abstract)
W90-01445

**TEST OF AN ERODIBILITY RATING SYSTEM FOR THE FOOTHILLS OF CENTRAL ALBERTA, CANADA.**
National Agrarian Univ., Lima (Peru). Dept. Manejo Forestal.
For primary bibliographic entry see Field 2J.
W90-01446

**PERFORMANCE OF GULLY EROSION CONTROL MEASURES IN SOUTHEASTERN NIGERIA.**

Nigeria Univ., Nsukka. Dept. of Geology.
C. O. Okagbue, and K. O. Uma.
IN: Forest Hydrology and Watershed Management. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication No. 167, 1987. p 163-172, 5 fig, 1 tab, 8 ref.

Descriptors: *Nigeria, *Forest management, *Erosion control, *Reforestation, Gullies, Check dams.

The performance of gully erosion control measures in some parts of southeastern Nigeria is presented. The measures include tree planting, hydraulic regulation works that integrate a drainage network with storage ponds to cut off flood crests and lower hydraulic loads of interceptor canals, and stabilization works such as check dams on the main channels of gullies and wickerwork fences and hedges at the inner gully slopes. There is evidence that tree planting and surface regulation of surface waters is effective in controlling only shallow (<15 m deep) gullies that have not cut through a saturated zone. These measures tend to fail when used for deep gullies that are greatly affected by groundwater especially when such gully floors are located in noncohesive and very permeable sands. (See also W90-01432) (Author's abstract)
W90-01447

**POSSIBLE HYDROLOGICAL AND GEOMORPHOLOGICAL CHANGES DUE TO ALTERATION OF FOREST.**
Kyoto Univ. (Japan).
For primary bibliographic entry see Field 4C.
W90-01448

**EVALUATION OF THE EFFECT OF DEFORESTATION ON SLOPE STABILITY AND ITS APPLICATION TO WATERSHED MANAGEMENT.**
Tokyo Univ. of Agriculture and Technology (Japan). Dept. of Forestry.
For primary bibliographic entry see Field 4C.
W90-01449

**EFFECT OF DIFFERENT TYPES OF FOREST MANAGEMENT ON THE TRANSFORMATION OF RAINFALL ENERGY BY THE CANOPY IN RELATION TO SOIL EROSION.**
Silsoe Coll. (England). Dept. of Field Engineering.
J. Brandt.
IN: Forest Hydrology and Watershed Management. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication No. 167, 1987. p 213-222, 2 fig, 1 tab, 22 ref. Natural Environment Research Council Grant No. GT4/82/AAPS/59.

Descriptors: *Forest hydrology, *Forest management, *Soil erosion, *Model studies, *Rainfall intensity, *Throughfall, Energy, Canopy.

Rainfall energy and intensity are commonly used in a model describing the initiation of soil erosion by splash on a bare soil surface. The effects of a vegetation canopy on splash may be incorporated into such models by considering the change in rainfall drop-size distribution by the canopy. Throughfall kinetic energy/unit vol is shown to be independent of both rainfall energy and intensity and to be determined by processes operating within the canopy. Total throughfall kinetic energy for any storm may be simulated if the frequency distribution of the values of kinetic energy/unit vol is known. At a basic level the frequency distribution of total kinetic energy values may be simulated from random values of mean kinetic energy and total throughfall depth. Refinement of the model will come in reducing the range of possible values of kinetic energy/unit vol at any period during the storm. (See also W90-01432) (Author's abstract)
W90-01452

**GEOMORPHIC AND VEGETATIVE RECOVERY PROCESSES ALONG MODIFIED TENNESSEE STREAMS: AN INTERDISCIPLINARY APPROACH TO DISTRIBUTED FLUVIAL SYSTEMS.**
Geological Survey, Nashville, TN.
For primary bibliographic entry see Field 6G.
W90-01456

**FOREST HARVEST, SNOWMELT AND STREAMFLOW IN THE CENTRAL SIERRA NEVADA.**
Pacific Southwest Forest and Range Experiment Station, Berkeley, CA.
L. H. MacDonald.
IN: Forest Hydrology and Watershed Management. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication No. 167, 1987. p 273-283, 3 fig, 18 ref.

Descriptors: *Water yield improvement, *California, *Forest management, *Forest hydrology, *Snowmelt, *Streamflow, Tracers, Sierra Nevada.

Forest harvest techniques have often been suggest as a means of increasing snow accumulation and beneficially delaying snowmelt in the Northern and Central Sierra Nevada mountains in California. To test the effect of such management practices on streamflow, extended snowmelt was simulated in June 1985 on four 960 sq m plots in a 50 ha drainage basin. Less than 1% of a bromide tracer in the simulated snowmelt was detected at a downstream weir through the summer and early fall of 1985. Although significant increases in the water table and soil moisture content were found in the treated plots and, in some cases, downslope, the simulated snowmelt apparently did not substantially increase streamflow in 1985. The consistently high concentrations of bromide observed at the weir in 1986 are believed to be a function of basin lithology. The results to date cast doubt on the linkage that can be made between an increase in snow water equivalent on the hillslope and downstream discharge. (See also W90-014323) (Author's abstract)
W90-01458

**TRANSPIRATION OF MATURE STANDS OF SPRUCE (PICEA ABIES (L.) KARST.) AS ESTIMATED BY THE TREE-TRUNK HEAT BALANCE METHOD.**
Vysoka Skola Zemedelska, Brno (Czechoslovakia). Inst. of Forest Ecology.
J. Cermak, and J. Kucera.
IN: Forest Hydrology and Watershed Management. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication No. 167, 1987. p 311-317, 3 fig, 2 tab, 10 ref.

Descriptors: *Forest hydrology, *Transpiration, *Heat balance, *Spruce trees, Trees, Czechoslovakia.

The tree-trunk heat balance method for determining transpiration rates was applied to fully grown spruce trees and stands in a hilly region of south Moravia, Czechoslovakia. The maximum transpiration of a single tree was 130 L/day, that of the spruce stand 45mm/mo. For the growing season it totaled 180-280 mm, dependent on precipitation and soil moisture conditions. Dry soil caused the transpiration rate to decrease, thus jeopardizing survival of the trees. (See also W90-01432) (Author's abstract)
W90-01461

**MULTICRITERION FOREST WATERSHED RESOURCES MANAGEMENT.**
Arizona Univ., Tucson. School of Renewable Natural Resources.
For primary bibliographic entry see Field 6A.
W90-01490

**DEFINITE PROJECT REPORT FOR SECTION 14 EMERGENCY STREAMBANK PROTECTION: NORTH RACOON RIVER, IOWA STATE HIGH 7 BRIDGE IN BUENA VISTA COUNTY, IOWA.**
Army Engineer District, Rock Island, IL.
Available from the National Technical Information Service, Springfield, VA 22161, as AD-A198 703. Price codes: A03 in paper copy, A01 in microfiche. February 1988. 40p, 7 tab, 5 plates, 2 append.

Descriptors: *Erosion control, *Iowa, *Bank protection, Raccoon River, Erosion, Hydraulic structures, Riprap, Costs, Construction.

This letter report is a summary of a study made on providing emergency streambank protection along the left descending bank of the North Raccoon River to curtail erosion which is endangering the east approach roadway, abutment wingwall, and deck of the Iowa State Highway 7 bridge in Buena Vista County, Iowa. The proposal for emergency streambank protection presented in this report recommends the placement of riprap on rock bedding along approximately 375 linear feet of the left downstream bank of the North Raccoon River. The total estimated cost for the project is $33,900, with a benefit-to-cost ratio of 17.3. The project satisfies the criteria for Federal participation and is recommended for construction. (Lantz-PTT)
W90-01713

**COOPERATION FOR RECREATION AND STREAMBANK RETENTION--THE TIOGA COUNTY EXPERIENCE.**
Tioga County Planning Board, Oswego, NY.
P. Smyth, and J. E. Barnes.
IN: Stormwater Management Alternatives. Water Resources Center, University of Delaware, Newark, DE. April 1980. p 69-72. 1 fig.

Descriptors: *Water pollution control, *Storm water management, *Urban hydrology, *Bank protection, *Stream improvement, *Erosion control, *New York, *Tioga County, Environmental protection, Regional development, Stream erosion.

The streambank erosion rate contributes over 70 tons of sediment per bank mile in New York State. Results of grassroot sampling in 1978 suggested that streambank erosion/sedimentation was a number one priority in New York's Southern Tier counties. Tioga County, New York took the initiative in instituting an improvement program on several segments of a major stream system--the East and West Branches of Owego Creek. As early as 1968, the Directors of the Tioga County Soil and Water Conservation District placed a priority on an action-oriented program designed to obtain results in streambank retention, improve trout stream habitat and to gain better access to fishing as a recreation. This action-oriented program recognized that the vagaries of a natural stream could wreak havoc on various land resources and could cause many dollars worth of damage not only to man's economic environment but also to his natural environment. The majority of structures built provided a function of maintaining a narrow streambed which also reduced flooding and bank erosion. Creation of pools and shaded areas decreased the water temperature. Willow and dogwood seedlings were planted in stream retention areas. As a result, former sources of erosion and sedimentation have been stifled. Flooding and flood damage has also been reduced. (See also W90-01919) (Mertz-PTT)
W90-01926

**PLANNING FOR RIPARIAN ENVIRONMENTAL QUALITY OPTIONS IN A SMALL WATERSHED IN NEW JERSEY.**
Betz, Converse, Murdock, Inc., Plymouth Meeting, PA.
A. M. Robinson, and C. R. Collier.
IN: Stormwater Management Alternatives. Water Resources Center, University of Delaware, Newark, DE. April 1980. p 121-139. 5 fig, 4 tab.

Descriptors: *Water pollution control, *Storm water management, *Urban hydrology, *New Jersey, *Watershed management, *Storm water, *Storm runoff, *Stream stabilization, Environmental protection, Mercer County.

Hydrologic, environmental and fiscal analyses of proposed Master Plan Development in the Pond

Run watershed in Hamilton Township, Mercer County, New Jersey were conducted to develop measures to mitigate the plan's potential impacts. Two major measures--stream corridor protection and strict stormwater management--were selected to minimize additional flood hazards and maximize environmental quality. The dimensions of the stream corridors and degree of stormwater management proposed for Pond Run are partially a function of the broad flood plain and gently sloping terrain and the existing flood plain development pattern. Although flood plain characteristics and open space opportunities vary considerably, preserving a naturally vegetated stream buffer, prohibiting upstream channelization, prohibiting fill in the flood plain, and applying stormwater management will greatly assist in achieving the goal of sound urban watershed management. (See also W90-01919) (Mertz-PTT)
W90-01930

**STREAM VALLEY AND FLOOD PLAIN MANAGEMENT IN MONTGOMERY COUNTY, MARYLAND.**
Maryland-National Capital Park and Planning Commission, Silver Spring.
N. Baig, and W. H. Blood.
IN: Stormwater Management Alternatives. Water Resources Center, University of Delaware, Newark, DE. April 1980. p 247-253. 1 fig, 2 ref.

Descriptors: *Water pollution control, *Storm water management, *Urban hydrology, *Watershed management, *Streams, *Maryland, *Environmental protection, Conservation, Montgomery County.

Preservation and conservation of stream valleys in Montgomery County, Maryland was established as an objective and became county policy with the establishment of the Maryland-National Capital Park and Planning Commission back in 1927. Involved in all aspects of planning, the Commission has placed a strong priority on preservation and conservation. Stemming from this philosophy the stream valley acquisition program evolved. The goals and objectives of the program were to protect the integrity of the streams, preserve the natural and historic features found in stream valleys and flood plains, and minimize damage to personal property resulting from flood waters. In order to achieve these goals and objectives, the Commission set out to acquire through either purchase or dedication, the streamside land of all major streams in Montgomery County. Since the inception of the program and as new insight and awareness of the fragile nature of the environment developed, the program took on the task of protection and conservation of valuable natural resources. While the program of stream valley acquisition has not been effective in acquiring all streams, the Commission has become an integral part of the total watershed management planning in Montgomery County. (See also W90-01919) (Mertz-PTT)
W90-01936

**PUBLIC PARTICIPATION IN ANNE ARUNDEL COUNTY'S WATER SHED MANAGEMENT PROGRAM.**
Anne Arundel County Office of Planning and Zoning, Annapolis, MD.
G. Klingelhoefer, C. E. Abrahamson, and F. W. Ellis.
IN: Stormwater Management Alternatives. Water Resources Center, University of Delaware, Newark, DE. April 1980. p 325-335. 2 fig.

Descriptors: *Water pollution control, *Storm water management, *Urban hydrology, *Maryland, *Watershed management, *Urban planning, Community development.

Anne Arundel County, Maryland started a Watershed Management Program that incorporated citizen involvement in all stages of the program. Citizens participated in the identification of the study area, the development of the work program and the selection of consultants. For the first watershed considered, Severn Run, citizens were involved throughout the study, including review of all draft documents. This approach to comprehensive public involvement from the start of a study and particularly a major county-wide watershed management program, was unique within the Baltimore-Washington region. (See also W90-01919) (Author's abstract)
W90-01943

# 5. WATER QUALITY MANAGEMENT AND PROTECTION

## 5A. Identification Of Pollutants

**CLOSED SYSTEM SAMPLE TRANSFER DEVICE FOR VOLATILE ORGANIC COMPOUNDS.**
Wisconsin Univ., Madison. Dept. of Soil Science.
R. D. Morrison.
Water Resources Bulletin WARBAQ, Vol. 25, No. 3, p 637-640, June 1989. 2 fig, 9 ref.

Descriptors: *Water analysis, *Pollutant identification, *Sampling, *Volatile organic compounds, *Groundwater quality.

A sample transfer device was designed to provide a closed loop sampling system between a groundwater sampling pump and a 40 ml volatile organic compound (VOC) vial. The same attachment can also be used with a bailer. The unit is constructed of a polytetrafluoroethylene (PTFE) body into which two stainless steel needles are press fitted. The needles puncture the Teflon septum of a vial; fluid flows through the longer needle into the vial and exists the vial from the shorter needle. The device eliminates sample transfer bias associated with head space, visible gas bubbles, and atmospheric contamination. Field sampling designed to determine differences in trichloroethylene (TCE) concentrations presumedly due to the device were statistically significant in one case, and insignificant in the second. (Author's abstract)
W90-00979

**METHODS AND EXPERIENCES OF MONITORING AMMONIA, NITRATE, CARBON DIOXIDE, PHOSPHORUS AND CHLOROPHYLL-A IN WATER POLLUTION CONTROL OF RUNNING WATERS (MOGLICHKEITEN UND ERFAHRUNGEN MIT MEBSTATIONEN AN FLIEBGEWASSERN, INSBESONDERE DER KONTINUIERLICHEN ERFASSUNG VON AMMONIUM, NITRAT, KOHLENSTOFFDIOXID, 0-PHOSPHAT UND CHLOROPHYLL-A).**
Bayerische Landesanstalt fuer Wasserforschung, Munich (Germany, F.R.).
V. M. Siepmann, W. Pohlmann, and W. Kopf.
Journal for Water and Wastewater Research ZWABAQ, Vol. 22, No. 4, p 145-151, 1989. 10 fig, 9 ref. English summary.

Descriptors: *Monitoring, *Water pollution control, *Measuring instruments, *Chemical analysis, Streams, Ion sensitive electrodes.

Methods and experiences concerning the monitoring and control of water-pollution in running waters are described. General comments concerning monitoring stations and measurements of conventional parameters such as pH, oxygen, temperature, turbidity and solarity are given. Particular emphasis is given to the testing of the new method using ion sensitive electrodes (ammonia, chlorophyll-a, ortho-phosphate). Nitrification processes in water supplies are found to influence the analytical results of the nitrogen parameters. These disadvantages are eliminated by an ultrafiltration of the analyzed water which also avoids the obstruction of the monitors by suspended matter. Results of water-pollution-monitoring by these methods are also presented. (Author's abstract)
W90-00985

**DETERMINATION OF ORGANOCHLORINE PESTICIDES IN INDIAN COASTAL WATER USING A MOORED IN-SITU SAMPLER.**
National Inst. of Oceanography, Panaji (India). Chemical Oceanography Div.
For primary bibliographic entry see Field 5B.
W90-00995

**OXYGEN UPTAKE RATE APPROACH FOR ANALYSING RESPIROMETRIC BIOCHEMICAL OXYGEN DEMAND DATA: I. METHOD DEVELOPMENT.**
McGill Univ., Montreal (Quebec). Dept. of Civil Engineering.
M. D. Cailas, and R. Gehr.
Water Research WATRAG, Vol. 23, No. 8, p 985-992, August 1989. 4 fig, 37 ref, append.

Descriptors: *Instrumentation, *Water analysis, *Biochemical oxygen demand, *Measuring instruments, *Model studies, *Data acquisition, Data processing, Oxygen uptake rate.

When electrolytic and other continuous respirometers are used for monitoring the progression of a Biochemical Oxygen Demand (BOD) curve, cumulative data are required. The structure of these data limits the reliable application of existing methodologies for estimating typical BOD parameters such as the rate constant and the ultimate BOD value. In this case, it is proposed that the Oxygen Uptake Rate (OUR) should be used instead as the data source for further analysis, instead of the cumulative form. To model the OUR data trend, 1st and 2nd-order models are proposed. Theoretical examination of the properties of these OUR models indicate that they are likely to have improved nonlinear behavior, and that their parameters will have more reliable confidence interval estimates. Furthermore, the optimal duration of an experiment performed to estimate OUR-BOD parameters is shorter, compared to that required for estimating similar parameters, in the case of cumulative data. (See also W90-00998) (Author's abstract)
W90-00997

**OXYGEN UPTAKE RATE APPROACH FOR ANALYSING RESPIROMETRIC BIOCHEMICAL OXYGEN DEMAND DATA: II. APPLICATION AND EVALUATION.**
McGill Univ., Montreal (Quebec). Dept. of Civil Engineering.
For primary bibliographic entry see Field 7A.
W90-00998

**COLIPHAGES AS INDICATORS OF FAECAL POLLUTION AT THREE RECREATIONAL BEACHES ON THE FIRTH OF FORTH.**
Forth River Purification Board, Edinburgh (Scotland).
B. O'Keefe, and J. Green.
Water Research WATRAG, Vol. 23, No. 8, p 1027-1030, August 1989. 1 fig, 2 tab, 28 ref.

Descriptors: *Pollutant identification, *Bacterial analysis, *Coliforms, *Bioindicators, Contamination, Beaches, Fecal contamination, Scotland, Coliphages, Correlation analysis.

The levels of bacteriophages specific to Escherichia coli was compared to the levels of bacterial indicators in the water at three recreational beaches on the Firth of Forth. Beaches were chosen on the basis that they were known to suffer widely different degrees of fecal contamination. A direct plaque assay using 100 ml water samples was used to enumerate coliphages, and total coliforms and fecal coliforms were enumerated by membrane filtration. There was a high degree of correlation between the levels of coliphages and coliforms between the three sites studied. Within sites, levels of coliphages and coliforms showed a high degree of correlation on the two highly-polluted beaches, whereas correlation was low on the less-polluted beach. At the less-polluted beach coliphages were detected in the absence of fecal coliforms on two occasions, whereas fecal coliforms were detected in the absence of coliphages on one occasion. The results suggest that coliphages are as adequate indicators of fecal pollution at the sites studied as are coliform bacteria. (Author's abstract)
W90-01002

**CHEMICAL OXYGEN DEMAND (COD) USING MICROWAVE DIGESTION.**
Universidade Estadual de Campinas (Brazil). Inst. de Quimica.
For primary bibliographic entry see Field 7B.
W90-01007

**INFERRING PH FROM DIATOMS: A COMPARISON OF OLD AND NEW CALIBRATION METHODS.**
Instituut TNO voor Wiskunde, Informatieverwerking en Statistiek, Wageningen (Netherlands).
C. J. F. ter Braak, and H. van Dam.
Hydrobiologia HYDRB8, Vol. 178, No. 3, p 209-223, Jul 17 1989. 3 fig, 5 tab, 58 ref. European Community (Contract no. ENV-650-N (N).

Descriptors: *Hydrogen ion concentration, *Calibrations, *Diatoms, *Acid rain, *Bioindicators, *Littoral zone, *Lakes, Gaussian model, Maximum likelihood method, Weighted averaging method.

Two new methods for inferring pH from diatoms are presented. Both are based on the observation that the relationships between diatom taxa and pH and often unimodal. The first method is maximum likelihood calibration based on Gaussian logit response curves of taxa against pH. The second is weighted averaging. In a lake with a particular pH, taxa with an optimum close to the lake pH will be most abundant, so an intuitively reasonable estimate of the lake pH is to take a weighted average of the pH optima of the species present. Optima and tolerances of diatom taxa were estimated from contemporary pH and proportional diatom counts in littoral zone samples from 97 pristine soft water lakes and pools in Western Europe. The optima showed a strong relation with Hustedt's pH preference groups. The two new methods were then compared with existing calibration methods on the basis of differences between inferred and observed pH in a test set of 62 additional samples taken between 1918-83. The methods were ranked in order of performance as follows (between brackets the standard error of inferred pH in pH units); maximum likelihood (0.63)>weighted averaging (0.71)=multiple regression using pH groups (0.71)=the Gasse & Tekaia method (0.71)>Renberg & Hellberg's Index B (0.83)>>multiple regression using taxa (2.2). The standard errors are larger than those usually obtained from surface sediment samples. The relatively large standard error may be due to seasonal variation and to the effects of other factors such as humus content. The maximum likelihood method is statistically rigorous and can in principle be extended to allow for additional environmental factors. It is computer intensive however. The weighted averaging approach is a good approximation to the maximum likelihood method and is recommended as a practical and robust alternative. (Author's abstract)
W90-01015

**SUBLETHAL EFFECTS OF ZINC AND MUNICIPAL EFFLUENTS ON LARVAE OF THE RED ABALONE HALIOTIS RUFESCENS.**
California Univ., Santa Cruz. Inst. of Marine Sciences.
For primary bibliographic entry see Field 5C.
W90-01039

**DETERMINATION OF TRACE HEAVY METALS IN WATERS BY ATOMIC-ABSORPTION SPECTROMETRY AFTER PRECONCENTRATION BY LIQUID-PHASE POLYMER-BASED RETENTION.**
Akademiya Nauk SSSR, Moscow. Inst. Geokhimii i Analiticheskoi Khimii.
V. M. Shkinev, V. N. Gomolitskii, B. Y. Spivakov, K. E. Geckeler, and E. Bayer.
Talanta TLNTA2, Vol. 36, No. 8, p 861-863, Aug 1989. 1 fig, 2 tab, 8 ref.

Descriptors: *Pollutant identification, *Laboratory methods, *Chemical analysis, *Atomic absorption spectrophotometry, *Heavy metals, *Trace metals, Nickel, Copper, Zinc, Mercury, Cadmium, River water, Drinking water, Polymers.

A new method for the determination of metals in seawater by flame atomic absorption spectrometry is described. The metals are retained by water-soluble polymers in a membrane filtration cell; the factors which influence their determination are discussed. The method was applied to the determination of Ni, Cu, Zn, Hg and Cd in drinking and river water with poly(ethyleneimine) and its thiourea derivative as complexing polymers. The metals were determined in the aqueous concentrate after a 250-fold preconcentration by 2% polymer solution at pH 7.0. The metal recoveries were at least 92%, and the limits of detection (ng/mg) were 0.012 for Cu, 0.006 for Zn, 0.03 for Ni, 0.004 for Cd and 0.0001 for Hg (cold vapor method). When a new type of membrane filtration cell is used even higher preconcentration factors can be achieved and lower concentrations can be determined. (Author's abstract)
W90-01045

**GROUNDWATER QUALITY MONITORING IN RELATION TO ON-SITE SANITATION IN DEVELOPING COUNTRIES.**
Southampton Univ. (England). Inst. of Irrigation Studies.
For primary bibliographic entry see Field 5G.
W90-01098

**APPLICATION OF GENE PROBE METHODS FOR MONITORING SPECIFIC MICROBIAL POPULATIONS IN FRESHWATER ECOSYSTEMS.**
Louisville Univ., KY. Dept. of Biology.
R. J. Steffan, A. Breen, R. M. Atlas, and G. S. Sayler.
Canadian Journal of Microbiology CJMIAZ, Vol. 35, No. 7, p 681-685, July 1989. 2 fig, 1 tab, 30 ref. U.S. EPA cooperative agreement No. CR812488.

Descriptors: *Data acquisition, *Monitoring, *Microorganisms, *Pseudomonas, *Alcaligenes, Ecosystems, Microenvironment, DNA probe, Genetics.

Several gene probe methods were used to monitor specific microbial populations in freshwater microcosms. Detection methods included nonselective plating--colony hybridization, selective plating--colony hybridization, most probable number--filter hybridization, and community DNA extraction--dot blot hybridization. Tests were conducted in freshwater microcosms inoculated with a 4-chlorobiphenyl degrading Alcaligenes A5 or a 2,4,5-trichlorophenoxyacetic acid degrading Pseudomonas cepacia AC1100. Colony hybridization performed on colonies detected on a nonselective medium sometimes failed to detect both Alcaligenes A5 and P. cepacia AC1100 when the target populations comprised less than 0.1% of the total population, even though the target populations were present at concentrations of greater than 10000 viable cells/mL as indicated by other detection methods. Selective plating--colony hybridization, most probable number--filter hybridization, and dot blot hybridization using DNA extracted from the microbial community consistently indicated persistence of the added P. cepacia AC1100 in the microcosms. Although differing in their detection reliability and sensitivity, the various gene probe detection methods indicated persistence with a slow decline of both the Alcaligenes A5 and P. cepacia AC1100 over an 8-week period. (Author's abstract)
W90-01111

**METALLIC BIOACCUMULATION IN AQUATIC PLANTS (BIOACCUMULATION DES METAUX DANS LES VEGETAUX AQUATIQUES).**
Ecole Nationale Superieure de Geologie Appliquee et de Prospection. Miniere, Nancy (France). Centre de Valorisation des Minerais.
C. Genin-Durbet, Y. Champetier, and P. Blazy.
Comptes Rendus de l'Academie des Sciences (Series 2) CRASEV, No. 18, p 1875-1877, 1988. 2 tab, 14 ref.

Descriptors: *Pollutant identification, *Bioindicators, *Bioaccumulation, *Aquatic plants, *Metals, Elodea, Cadmium, Mercury, Lead, Zinc, Copper, Nickel.

The capacity of bacteria and algae to trap lead, zinc, copper, mercury, and nickel, was studied in aquaria. Plants were cultivated under the following conditions: temperature, 21 C: time, 72 hrs; pH, 4.5; light, permanent; metal amounts, 2 mg/L. Elodea displayed a great capacity to accumulate metals, especially cadmium and mercury. It is therefore recommended that Elodea be used to detect pollution 'on the move' in water and the flux of water polluted by metals. (Peters-PTT)
W90-01143

**ASSOCIATIONS AND DISTRIBUTION OF BENTHIC NEMATODES IN THE ETHIOPIAN RIFT VALLEY LAKES.**
Waterloo Univ. (Ontario). Dept. of Biology.
For primary bibliographic entry see Field 2H.
W90-01157

**IDENTIFICATION OF OZONATION BY-PRODUCTS OF LIGNIN AND OF CARBOHYDRATES IN WATER (ETUDE DES SOUS-PRODUITS D'OZONATION DE LA LIGNINE ET DE GLUCIDES EN MILIEU AQUEUX).**
Poitiers Univ. (France). Lab. de Chimie de l'Eau et des Nuisances.
For primary bibliographic entry see Field 5F.
W90-01234

**DETERMINATION OF TRACE METALS IN REFERENCE WATER STANDARDS BY INDUCTIVELY COUPLED PLASMA MASS SPECTROMETRY WITH ON-LINE PRECONCENTRATION.**
National Research Council of Canada, Ottawa (Ontario). Div. of Chemistry.
D. Beauchemin, and S. S. Berman.
Analytical Chemistry ANCHAM, Vol. 61, No. 17, p 1857-1862, September 1, 1989. 5 fig, 6 tab, 28 ref.

Descriptors: *Pollutant identification, *Metals, *Water analysis, *Chemical analysis, *Trace metals, *Mass spectrometry, Preconcentration, Water standards, Lakes, Rivers, Inductively coupled mass spectrometry.

A preliminary implementation on-line preconcentration in inductively coupled plasma mass spectrometry (ICP-MS) improved the detection limits of several elements by a factor of 2-7 compared to ICP-MS alone. The on-line preconcentration system was first assessed by using the method of standard additions to determine MN, Co, Ni, Cu, Pb, and U in the certified riverine water SLRS-1 whose salt content was low enough to allow monitoring both the preconcentration and the elution processes. Results in good agreement with the certified values were obtained for all but Ni, because of a spectral interference by CaO from coeluted Ca. The system was successfully applied to the determination of MN, Mo, Cd and U in the reference open ocean water NASS-2 using an isotope dilution technique and the method of standard additions. The implementation of on-line preconcentration in ICP-MS can both speed up the sample pretreatment of seawater and decrease the same consumption drastically. With the original procedure, the preconcentration of NASS-2 required 500-ml aliquots whereas only 10-ml aliquots were needed by on-line preconcnetration. Furthermore, a preconcentration by a factor of 50 was found to be necessary with the original procedure in order to get reliable values for Cd, whereas a factor of 10 was quite sufficient with on-line preconcentration because of the additional enhancement in sensitivity which results when elutions are followed in real time. Finally, at least 8 h was required with the original procedure for the analysis of three samples of NASS-2 and three column blanks; only 45 min was needed with on-line preconcentration. (Miller-PTT)
W90-01237

**EVALUATION OF SOME MYTHS CONCERNING THE CULTURE OF DAPHNIDS.**
Miami Univ., Oxford, OH. Dept. of Zoology.
R. W. Winner.
Aquatic Toxicology AQTODG, Vol. 14, No. 4, p

323-330, May 1989. 2 fig, 2 tab, 17 ref.

Descriptors: *Bioindicators, *Daphnia, *Crustaceans, Fecundity, Air bubbles, Hard water.

Three myths are evaluated: (1) daphnids must be gently released under the surface of the culture water when transferred or they will collect air bubbles under the carapace and are more likely to become floaters, (2) daphnid cultures, especially Daphnia magna, are healthier in hard water than in soft water, and (3) the fecundity of females, and the viability of their offspring, decrease as the females age. Contrary to established belief, it is concluded that: (1) daphnids can, without suffering damage, be droppped through the surface film of water, (2) an increase in the hardness of culture water does not results in healthier daphnids as measured by body growth, survival or reproduction, and (3) the fecundity of a healthy female does not decrease with age. Finally, it is pointed out that there has never been a demonstration of a Lansing effect for any species in the genus Daphnia and, therefore, there is no reason to believe that the vitality of neonates decreases as the age of their mother increases. (Miller-PTT)
W90-01239

**TOXICITY TESTING USING IMMOBILIZED ALGAE.**
Florida Univ., Gainesville. Dept. of Environmental Engineering Sciences.
J. Bozeman, B. Koopman, and G. Bitton.
Aquatic Toxicology AQTODG, Vol. 14, No. 4, p 345-352, May 1989.

Descriptors: *Algae, *Water pollution effects, *Bioassay, *Pesticides, *Heavy metals, *Herbicides, *Toxicity, Immobilization, Cadmium, Copper, Pentachlorophenol.

The usage of alginate-immobilized algae for testing the toxicity of cadmium, copper, pentachlorophenol, sodium dodecyl sulfate, and three herbicides (Glyphosate, Hydrothol, and Paraquat) are reported. Toxicity of the chemicals to freely suspended algal cells in the same media was also determined for comparison. Alginate-immobilized and free Selenastrum capricornutum Printz cells were cadmium, copper, Glyphospahte, Hydrothol, Paraquat, pentachlorophenol, and sodium dodecyl sulfate. Toxicity was characterized in terms of growth inhibition, with growth measured by in vitro chlorophyll fluorescence. Sensitivity of the immobilized and free algal assays to copper, cadmium and pentachlorophenol was similar. However, immobilization substantially reduced the toxicity of Hydrothol, Paraquat, and Glyphosate to the algae. Sodium dodecyl sulfate disrupted the alginate matrix and its toxicity could be determined successfully with the immobilized algal assay. (Author's abstract)
W90-01241

**ANALYSIS OF TRIFLURALIN, METHYL PARAOXON, METHYL PARATHION, FENVALERATE AND 2,4-D DIMETHYLAMINE IN POND WATER USING SOLID-PHASE EXTRACTION.**
Patuxent Wildlife Research Center, Laurel, MD.
D. M. Swineford, and A. A. Belisle.
Environmental Toxicology and Chemistry ETOCDK, Vol. 8, No. 6, p 465-468, 1989. 1 fig, 1 tab, 16 ref.

Descriptors: *Pollutant identification, *Pesticides, *Chemical analysis, *Water analysis, *Ponds, *Parathion, *Chromatography, Extraction, Trifluralin, Fenvalerate, Dimethylamine.

A method was developed for the simultaneous extraction of trifluralin, methyl paraoxon, methyl parathion, fenvalerate, and 2,2-D dimethylamine salt in pond water using a solid-phase C18 column. After elution from the C18 column, the eluate was analyzed on a capillary gas chromatograph equipped with an electron-capture or flame photometric detector. By using specific gas chromatography (GC) detectors and capillary columns for the analysis, it was possible to reduce the time required for purification and minimize interference at low residue levels. GC-mass spectrometry was employed to confirm the identity of the target compounds. The C18 solid phase extraction procedure demonstrated the ability to simultaneously isolate and concentrate the target compounds in pond water in a rapid and efficient manner. Acceptable recoveries were obtained at all four spiking levels; median recoveries for the individual compounds were 81% (fenvalerate), 91% (trifluralin), 93% (methyl parathion), 95% (2,4-D dimethylamine) and 97% (methyl paraoson). Controls of unfortified pond water were free of GC interference for the target compounds except for some minor GS interference at low quantitation levels of trifluralin, which alumina helped to remove. The detection limit of the method for the listed compounds in pond water will vary depending on the sample matrix. Additional cleanup of the sample may be necessary to quantitate some compounds below the 0.001 ppm level. (Miller-PTT)
W90-01258

**ISOLATION OF TOXINS FROM NATURAL BLUE-GREEN ALGAE AND UNICELLULAR CULTURED MICROCYSTIS AERUGINOSA.**
National Inst. of Hygienic Sciences, Tokyo (Japan).
H. Jinno, M. Ando, S. Matsui, and M. Takeda.
Environmental Toxicology and Chemistry ETOCDK, Vol. 8, No. 6, p 493-498, 1989. 1 fig, 3 tab, 28 ref.

Descriptors: *Pollutant identification, *Toxicity, *Toxins, *Cyanophyta, Cultures, Microcystis.

The differences between toxins derived from natural populations and cultures of Microcystis aeruginosa and Microcystis viridis, and the toxins of harvested extracts from four strains of Microcystis were investigated using DEAE-cellulose chromatography. Toxins extracted from algal populations consisting of 75% (total Microcystis cells/ml) M. aeruginosa from Lake Kasumigaura (Japan) contained an F-II fraction determined by ion-exchange chromatography; toxins extracted from algal populations consisting of 70% M. viridis from Lake Suwa (Japan) also contained this fraction. Using an improved gradient procedure with ion-exchange chromatography to analyze crude extracts of unicellular cultures of M. aeruginosa strain PS-434, five extracted fractions--F-II, F-IV, F-V, F-VI and F-VII-were determined to contain toxic substances. These fractions were identified as toxic (intraperitoneal injection) in mouse toxicity studies. No toxic fractions were identified in cultures of M. aeruginosa strains NIES-44. Mice LD50s for the crude extracts of cultures of strain PS-434 and the extracts from Lakes Kasumigaura and Suwa were calculated at less than 89.5, 260 and 570 mg/kg, respectively. in natural populations of M. aeruginosa or M. viridis, four toxic fractions (F-IV, F-V, F-VI and FVII) were not found. (Author's abstract)
W90-01260

**SYNOPSIS OF FRENCH EXPERIMENTAL AND IN SITU RESEARCH ON THE TERRESTRIAL AND MARINE BEHAVIOR OF TC.**
CEA Centre de La Hague, Cherbourg (France). Lab. de Radioecologie Marine.
For primary bibliographic entry see Field 5B.
W90-01269

**DETERMINATION OF DI- AND TRIBUTYLTIN IN SEDIMENT AND MICROBIAL BIOFILMS USING ACIDIFIED METHANOL EXTRACTION, SODIUM BOROHYDRIDE DERIVATIZATION AND GAS CHROMATOGRAPHY WITH FLAME PHOTOMETRIC DETECTION.**
Maryland Univ., College Park. Dept. of Chemistry and Biochemistry.
C. L. Matthias, J. M. Bellama, G. J. Olson, and F. E. Brinckman.
International Journal of Environmental Analytical Chemistry IJEAA3, Vol. 35, No. 2, p 61-68, 1989. 1 fig, 1 tab, 17 ref.

Descriptors: *Pollutant identification, *Organotins, *Pesticides, *Antifoulants, *Sediments, *Gas chromatography, *Flame photometry, *Organotin compounds, Biofilms.

A method for the relatively rapid determination of di- and tributyltin species in sediment and microbial biofilms is presented. Bi- and tributyltin species were detected in Chesapeake Bay sediments using this method. Microbial biofilms grown on glass slides exhibited substantial accumulation of tributyltin species from solution. The approach involves reflux with acidified methanol, followed by extraction into cyclohexane, and conversion to the respective butyltin hydrides using aqueous sodium borohydride. Speciation and quantitation was accomplished by gas-liquid chromatography using tin-selective flame photometric detection. This approach has the advantage of being more rapid than some other sediment tributyltin analysis techniques mainly because shorter refux times were required for tributyltin extraction. It also utilizes a water miscible solvent (methanol), preventing the need for drying the samples. This method should have useful application to sediment analysis of di- and tributyltin species and for studies on the accumulation and fate of tributyltin in microbial biofilms. (Miller-PTT)
W90-01280

**SPECIFIC PROCEDURE FOR METAL SOLID SPECIATION IN HEAVILY POLLUTED RIVER SEDIMENTS.**
Barcelona Univ. (Spain). Dept. of Analytical Chemistry.
G. Rauret, R. Rubio, J. F. Lopez-Sanchez, and E. Casassas.
International Journal of Environmental Analytical Chemistry IJEAA3, Vol. 35, No. 2, p 89-100, 1989. 5 fig, 4 tab, 15 ref.

Descriptors: *Pollutant identification, *Water analysis, *Chemical analysis, *Sediments, *Metals, *Speciation, Extraction, Tessier procedure, Chromium, Nickel, Copper, Lead, Distribution patterns.

Sequential extraction schemes are used in determining the partitioning of trace metals in sediments. Among them, the most widely used is that proposed by Tessier et al. A modified Tessier procedure with successive extractions until completeness is attained (using pH control for extraction of metal solubilized by acetic acid-acetate buffer, control of extracted iron and manganese for metal extracted by hydroxylamine hydrochloride and control of redox potential (Eh) of extractant solution for metal solubilized by hydrogen peroxide) is proposed for copper, lead, chromium and nickel speciation. Values obtained using the proposed multiple successive extraction procedure and those obtained using the Tessier procedure show an absolutely different pattern for copper and lead and a similar behavior for chromium and nickel can be observed. It can be concluded that, dealing with heavily polluted samples, the multiple successive extraction procedure yields a more reliable distribution pattern for copper and lead in which the residual metal is in good agreement with what is to be expected. For chromium and nickel, the differences in the distribution pattern are not important in spite of the very high contents of these metals. (Miller-PTT)
W90-01281

**OPTIMIZATION OF TESSIER PROCEDURE FOR METAL SOLID SPECIATION IN RIVER SEDIMENTS.**
Barcelona Univ. (Spain). Dept. of Analytical Chemistry.
G. Rauret, R. Rubio, and J. F. Lopez-Sanchez.
International Journal of Environmental Analytical Chemistry IJEAA3, Vol. 36, No. 2, p 69-83, 1989. 8 fig, 3 tab, 11 ref.

Descriptors: *Pollutant identification, *Water analysis, *Chemical analysis, *Metals, *Speciation, *Sediments, Tessier procedure, Partitioning, Copper, Lead, Nickel, Chromium.

Optimization of the Tessier procedure for trace metal partitioning in sediment was studied. The simplex optimization method was applied and the results indicate that the volume of extractant solution/weight of sediment ratio (V/m) is the main variable. Optimization of V/m ratio for second,

third and fourth fractions of Tessier scheme was studied on two different river sediments. The optimum values of V/m ratio obtained were applied for copper, lead, chromium and nickel partitioning. The results obtained are compared with those obtained using the Tessier procedure. It is concluded that the partitioning of heavy metals is sediments using the Tessier scheme is dependent either on the experimental procedure followed or on the sediment composition. This dependence is more obvious for heavily polluted sediments and for Pb and Cu more than for Cr and Ni. (Miller-PTT)
W90-01282

**DETERMINATION OF HEAVY METAL POLLUTION BY ICP AND AAS IN THE SUSPENDED MATTER OF THE GULF OF CADIZ.**
Instituto de Ciencias del Mar, Barcelona (Spain).
A. Palanques, F. Plana, M. Baucells, G. Lacort, and M. Roura.
International Journal of Environmental Analytical Chemistry IJEAA3, Vol. 36, No. 2, p 85-93, 1989. 3 fig, 3 tab, 5 ref.

Descriptors: *Water analysis, *Chemical analysis, *Water pollution, *Pollutant identification, *Heavy metals, *Marine environment, *Suspended solids, *Atomic absorption spectrophotometry, Littoral zone, Gulf of Cadiz, Cobalt, Titanium, Manganese, Chromium, Iron, Lead, Tinto/Odiel River, Ocean dumping.

High resolution analytical techniques (such as ICP, GFAAS and FAAS) are used to analyze heavy metal levels of marine suspended matter. In the Gulf of Cadiz, the littoral zone receives supplies of different metal concentrations from several source areas. The littoral pollution has been statistically defined by Co, Ti, Mn, Cr, Fe and Pb. Maximum concentrations of these elements were detected in front of the Tinto Odiel River. This is the most polluted of the sampled stations. Littoral pollution is detected in particles suspended in the shelf and in the slope waters. Waste dumped in the mid slope area is clearly defined by the high levels of Fe, Ti and Cr. However, no important anamoly has been detected in the metals concentration of particles suspended in the dumping area waters which could be associated with dumping activities. In general, metal concentrations of suspended matter from the mid slope waters decrease with respect to the ones detected in shallower waters. Metal distribution could indicate that seaward diffusive processes are more effective in the dispersion of metal from the shelf to the slope than coastal-parallel advective processes. In fact, metals seem to be dispersed along with particles independently of the suspended particulate matter concentration in the water column. A clear trend of depletion or enrichment of metals in the suspended particles has not been observed at any depth in the water column. (Miller-PTT)
W90-01283

**EXTRACTION-SPECTROPHOTOMETRIC DETERMINATION OF CHROMIUM(VI) WITH HYDROXYAMIDINE AND AMIDES.**
Ravishankar Univ., Raipur (India). Dept. of Chemistry.
C. Agarwal, K. S. Patel, and R. K. Mishra.
International Journal of Environmental Analytical Chemistry IJEAA3, Vol. 36, No. 2, p 95-101, 1989. 2 fig, 2 tab, 9 ref.

Descriptors: *Chemical analysis, *Industrial wastewater, *Pollutant identification, *Spectrophotometry, *Chromium, Coal, Dusts, Industrial wastes, Ash, Amides.

A new method was developed for selective extraction and spectrophotometric determination of microgram amount of chromium(VI) with N-hydroxy-N,N-diphenylbenzamidine (HOA) and N-aryl-acetamides (HL) in coal dust, coal ash, cement dust and industrial waste is described. It is based in chloroform extraction of (CrO2(OA)2) 2HL complex from 0.3-0.6 M hydrochloric acid solution. The molar absorptivity of (CrO2(OA)2) complex, with three different amides in chloroform, lies in the range 10000 to 13000 l/mole/cm at lamda sub max, and of these the simplest amide, N-phenylacetamide (PAA) has been selected for detailed study. The detection limit of the method is 0.01 microg Cr/ml. The relative standard deviation of the method for the recovery of the metal in the environmental samples is in the range of +or-0.8 to 1.3%. Examining the effect of diverse ions on the determination of the metal showed that most of the common metals except Mn(VII) did not interfere. (Author's abstract)
W90-01284

**DETERMINATION OF MERCURY IN SURFACE WATERS USING AN OPTIMIZED COLD VAPOR SPECTROPHOTOMETRIC TECHNIQUE.**
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Civil Engineering.
K. G. Robinson, and M. S. Shuman.
International Journal of Environmental Analytical Chemistry IJEAA3, Vol. 36, No. 2, p 111-123, 1989. 4 fig, 5 tab, 22 ref.

Descriptors: *Water analysis, *Chemical analysis, *Pollutant identification, *Mercury, *Surface water, *Spectrometry, Vaporization, Cold vapor spectrometry.

An analytical method to measure mercury in environmental samples was optimized based upon amalgamation of mercury on gold-coated sand and subsequent absorption measurement of the mercury vapor driven off the sand upon heating. Sample handling and storage methods were employed that were virtually free from mercury loss or contamination. Analytical procedures were tested on standard reference materials obtained from the USEPA and SGS and at concentration levels in the range anticipated for the environmental samples. Stream samples, collected over a seven-month period, were filtered (0.45 microm) in the field, and the mercury in dissolved and particulate fractions was determined. Dissolved mercury concentrations ranged from 24.1 ng/l to 116.9 ng/l (N = 120) while particulate mercury concentrations ranged from 0.2 mcirog/g to 33.4 microg/g (N = 120). The method has been found useful for analyzing environmental samples and has been shown to be very sensitive and free of interferences. (Author's abstract)
W90-01285

**EFFECT OF SUBSTRATA ON FLORA OF ATTACHED DIATOM ASSEMBLAGE WITH REFERENCE TO BIOLOGICAL WATER QUALITY ASSESSMENT, (IN JAPANESE).**
Kansai Univ., Osaka (Japan).
T. Watanabe, and N. Suzuki.
Japanese Journal of Limnology RIZAAU, Vol. 50, No. 2, p 129-137, April 1989. 6 fig, 1 tab, 23 ref. English summary.

Descriptors: *Pollution index, *Bioindicators, *Lakes, *Diatoms, *Water quality, *Algae, Artificial substrates, Organic compounds.

When the biological assessment of water pollution, using attached algal communities is done, an important problem is whether or not the algal flora are the same on different substrata. To make it clear in an artificial waterway, several facts were clarified through research. In the beginning of the succession process, the diatom assemblages were considerably different form each other between different substrata in their species components, and also the variation of their values of diatom assemblage index to organic water pollution (DAIpo) was large. However, the difference among the assemblages disappeared and DAIpo values became almost equal in a mature stage of succession. Samples collected from various substrata (in addition to stones or rocks) are useful to provide information on water pollution if samples in the mature stage of succession are used under prearranged conditions. (Author's abstract)
W90-01296

**ENVIRONMENTAL MONITORING OF CAGED FISH FARMING IN MACROTIDAL ENVIRONMENTS.**
Field Studies Council, Pembroke (Wales). Oil Pollution Research Unit.
For primary bibliographic entry see Field 8I.
W90-01330

**PROPOSAL FOR MODIFICATION OF THE BELGIAN BIOTIC INDEX METHOD.**
Antwerp Univ., Wilrijk (Belgium). Dept. of Biology.
L. Bervoets, B. Bruylants, P. Marquet, A. Vandelannoote, and R. Verheyen.
Hydrobiologia HYDRB8, Vol. 179, No. 3, p 223-228, July 28 1989. 2 fig, 5 tab, 15 ref.

Descriptors: *Bioindicators, *Biological samples, *Biotic index methods, *Stream biota, *Aquatic insects, *Aquatic populations, *Sampling, Belgium, Streams, Correlation analysis, Diversity.

A modification of the Belgian biotic index method from the point of view of reliability, time-consumption, and correlation with chemical water quality assessment along with the problem of sampling standardization were considered. Samples were taken from 14 brooks in the province of Antwerp, Belgium, and processed using three modifications of the biotic index (B.I.) method. The different B.I.s were then compared with the Chemical Index (C.I.). It was found that the B.I. is affected not only by water quality but by such factors as substrate nature, current speed, and food availability. It is recommended based on the comparison of modifications that: (1) samples should be processed live; (2) samples should not be washed through a series of sieves; and (3) systematic units represented by only one individual should be included in the calculation of the biotic index. Using these modifications, the biotic index can be calculated more rapidly and show a higher correlation with a chemical water quality assessment index. (White-Reimer-PTT)
W90-01374

**SURVIVAL AND ACTIVITY OF SALMONELLA TYPHIMURIUM AND ESCHERICHIA COLI IN TROPICAL FRESHWATER.**
Puerto Rico Univ., Rio Piedras. Microbial Ecology Lab.
For primary bibliographic entry see Field 5B.
W90-01377

**COMPARISON OF THE ABILITIES OF 15 MEDIA TO RECOVER VIABLE YEASTS FROM POND, RIVER, AND LAKE WATER.**
National Water Research Inst., Burlington (Ontario). Research and Applications Branch.
J. P. Sherry.
Journal of Microbiological Method JMIMDQ, Vol. 10, No. 1, p 39-46, July 1989. 4 tab, 14 ref.

Descriptors: *Sampling, *Yeasts, *Culturing techniques, *Culture media, *Growth media, Pond water, Lake water, River water, Quality control, Molds, Population estimates.

Membrane filtration (MF) is probably the most widely used technique for the recovery and enumeration of yeasts from freshwater. Because there is little information available on the comparative performances of the various agar-based media used in MF, a comparison was made of the abilities of 15 media to recover viable yeasts from pond, river, and lake water. The type of water filtered appeared to influence the abilities of the media to recover yeasts. Media containing glucose, that were also rich in peptone, yeast extract, and malt extract, tended to recover the most yeasts; however, no medium was clearly superior for all the water samples. Medium composition was observed to bias yeast-population estimates by up to 79%. Thus, it may be advisable to select optimal yeast-recovery media for individual water bodies. The results indicated that some nutrient-rich media were susceptible to mold overgrowth whereas low-nutrient media tended not to be susceptible. Elimination of yeast counts from filters that had > or = 25% of their surface area obscured by spreading molds tended to enhance yeast-population estimates with the river and pond-water types. (Author's abstract)

W90-01379

**PARTICULATE SULFATE LEVELS AT A RURAL SITE IN ISRAEL.**
Hebrew Univ., Jerusalem (Israel). School of Applied Science and Technology.
For primary bibliographic entry see Field 5B.
W90-01389

**CARBOXYLIC ACIDS AND CARBONYL COMPOUNDS IN SOUTHERN CALIFORNIA CLOUDS AND FOGS.**
California Inst. of Tech., Pasadena. W.M. Keck Lab. of Environmental Engineering Science.
For primary bibliographic entry see Field 5B.
W90-01398

**AIRBORNE ORGANOCHLORIDES IN THE CANADIAN HIGH ARCTIC.**
South Carolina Univ., Columbia. Dept. of Chemistry.
For primary bibliographic entry see Field 5B.
W90-01399

**ANALYSIS OF HUMIC SUBSTANCES USING FLOW FIELD-FLOW FRACTIONATION.**
Chisholm Inst. of Tech., Melbourne (Australia). Water Studies Centre.
For primary bibliographic entry see Field 7B.
W90-01496

**SEPARATION OF HUMIC SUBSTANCES AND ANIONIC SURFACTANTS FROM GROUND WATER BY SELECTIVE ADSORPTION.**
Kansas State Geological Survey, Lawrence.
E. M. Thurman, and J. Field.
IN: Aquatic Humic Substances: Influence on Fate and Treatment of Pollutants. American Chemical Society, Washington, DC. 1989. p 107-114, 2 tab, 30 ref.

Descriptors: *Water analysis, *Pollutant identification, *Humic acids, *Groundwater pollution, *Surfactants, Ion exchange, Chromatography.

Surface-active organic compounds, surfactants, may be isolated from ground water effectively on polymeric resins with a procedure nearly identical to the isolation procedure for humic substances. Surfactants, such as alkylbenzenesulfonates and alkyl sulfates, are sorbed from both distilled water and groundwater onto XAD-4 (styrene-divinylbenzene) resin at neutral pH (6-7). At this pH the majority of the humic substances are not sorbed, but pass through the XAD-4 resin. The effluent from the column is collected and the pH adjusted to 2.0 with concentrated hydrochloric acid. The solution is then passed through a second column of XAD-8 (methyl methacrylate) resin, and humic substances are sorbed. The surfactants and some colored substances are eluted from the SAD-4 column with methanol, and the humic substances eluted from the XAD-8 column with an aqueous solution of 0.1 N sodium hydroxide. The humic substances from the XAD-8 column are then ready for characterization without interference from anionic surfactants. Unfortunately, the surfactant fraction from the XAD-4 column does contain some colored humic material. (See also W90-01491) (Author's abstract)
W90-01499

**EFFECT OF DISSOLVED ORGANIC MATTER ON EXTRACTION EFFICIENCIES: ORGANOCHLORINE COMPOUNDS FROM NIAGARA RIVER WATER.**
State Univ. of New York at Syracuse. Coll. of Environmental Science and Forestry.
C. L. Fish, M. S. Driscoll, J. P. Hassett, and S. Litten.
IN: Aquatic Humic Substances: Influence on Fate and Treatment of Pollutants. American Chemical Society, Washington, DC. 1989. p 223-229, 1 fig, 1 tab, 13 ref.

Descriptors: *Pesticides, *Pollutant identification, *Chlorinated hydrocarbons, *Humic acids, *Separation techniques, *Niagara River, *Water analysis, *Polychlorinated biphenyls, DDT, DDE, Mirex, Comparison studies, Organic matter.

Two techniques for the extraction of a series of organochlorine compounds (chlorinated benzenes, polychlorinated biphenyls, DDT, DDE, and mirex) from centrifuged Niagara River water were compared. The more hydrophobic compounds were extracted more efficiently by a chromic acid digestion technique than by conventional hexane extraction. Plots of the relative recovery (R = undigested/digested) versus log of the octanol-water coefficient (Kow) show R decreasing exponentially with log Kow. This decrease suggests that the digestion-extraction recovers both the dissolved fraction and the fraction bound to organic matter, although conventional solvent extraction does not recover the bound fraction efficiently. (See also W90-01491) (Author's abstract)
W90-01506

**GEOCHEMISTRY OF DISSOLVED CHROMIUM--ORGANIC-MATTER COMPLEXES IN NARRAGANSETT BAY INTERSTITIAL WATERS.**
Rhode Island Univ., Narragansett. Graduate School of Oceanography.
G. S. Douglas, and J. G. Quinn.
IN: Aquatic Humic Substances: Influence on Fate and Treatment of Pollutants. American Chemical Society, Washington, DC. 1989. p 297-320, 10 fig, 5 tab, 35 ref. Marine Chemistry Program of the National Science Foundation Grant OCE-8200150.

Descriptors: *Water analysis, *Pollutant identification, *Chemical analysis, *Chromatography, *Path of pollutants, *Chromium, *Humic acids, *Narragansett Bay, *Estuarine environment, Fulvic acids, Sediments, Dissolved solids, Organic carbon, Metals, Chromatography, Spectroscopy, Hydrogen ion concentration, Interstitial water, Fate of pollutants.

C18 reverse-phase liquid chromatography and atomic absorption spectroscopy were employed to isolate and quantify dissolved interstitial chromium--organic-matter complexes in Narragansett Bay sediments. Concentration of total and organic chromium increased with depth in the core. The degree of chromium remobilization was dependent on the redox environment of the sediment and occurred mainly within the sulfate-reduction zone. Proton titration studies of interstitial water samples indicated that the chromium--organic-matter bond was exceptionally strong and that recovery could be increased significantly by protonating the normally dissociated anionic sites on the fulvic acid molecule. This protonation could decrease its polarity and increase its recovery through reverse-phase liquid chromatograph. The chromium--fulvic acid association may be an important factor in the transport of reduced chromium into oxic environments in the estuarine environment. (See also W90-01491) (Author's abstract)
W90-01511

**CHLORINATED HUMIC ACID MIXTURES: CRITERIA FOR DETECTION OF DISINFECTION BYPRODUCTS IN DRINKING WATER.**
Environmental Protection Agency, Cincinnati, OH. Drinking Water Research Div.
For primary bibliographic entry see Field 5F.
W90-01529

**MACROINVERTEBRATE BIOMONITORING AND WATER QUALITY MANAGEMENT WITHIN URBAN CATCHMENTS.**
Middlesex Polytechnic, Enfield (England). Urban Pollution Research Center.
A. D. Bascombe, J. B. Ellis, D. M. Revitt, and R. B. E. Shutes.
IN: Hydrological Processes and Water Management in Urban Areas. Proceedings of the International Symposium 24-29 April 1988, Duisburg, West Germany. International Hydrological Programme of UNESCO Publication, 1988. p 403-411, 3 fig, 6 ref.

Descriptors: *Monitoring, *Pollutant identification, *Macroinvertebrates, *Water quality control, *Urban runoff, Biological studies, Ecosystems, Water quality management, London, England.

The management role of benthic macroinvertebrate monitoring as a means for evaluating the impacts of transient urban discharges is described for a catchment in N. London, UK. Ecological variations and indices are identified and related to hydrochemical and toxic perturbations which prevent the establishment of a stable ecosystem. This kind of macroinvertebrate monitoring appears to be an advantageous way to assess urban runoff impacts and to evaluate qualitative, time-integrated approach to water quality management of urban rivers. Ecological approaches can either complement existing chemical procedures or provide a reliable, inexpensive alternative method for surface water quality classification, where chemical data are absent. Although biological monitoring can provide a practical and sensitive tool, there is still a need to further modify the ecological scoring system for transient discharges, and to identify an appropriate species for specifically monitoring toxic impacts. (See also W90-01612) (Lantz-PTT)
W90-01657

**DATA SUMMARY FOR TRINITROTOLUENE.**
Army Medical Research and Development Command, Fort Detrick, MD.
W. C. Roberts.
Available from the National Technical Information Service, Springfield, VA 22161, as AD-A199 118. Price codes: A03 in paper copy, A01 in microfiche. Technical Report 8611, September 1986. 34p, 78 ref.

Descriptors: *Water pollution sources, *Pollutant identification, *Monitoring, *Trinitrotoluene, *Public health, Drinking water, Organic compounds, Aquatic environment.

Trinitrotoluene (TNT) is produced in a batch or continuous mode by reacting toluene with nitric acid in the presence of sulfuric acid. Manufacture and load assembly, and pack (LAP) operations provide several opportunities for TNT and its products to enter the environment. Wastewater discharged from Army ammunition plants (AAP) is the primary way that TNT enters the aquatic environment. Up to 60 mg/L of TNT have been found in stream and river waters that receive waste effluent from AAPs, and associated sediments have contained up to 617 mg/kg. TNT does not transport very well through soil into groundwater, and atmospheric transport is not environmentally significant. It is persistent in soils, but is rapidly degraded in aquatic environments. The recommended longer term health advisory for TNT levels in drinking water sources is 0.040 mg/L (40 micrograms/L (ug/L)). At or below 0.040 mg/L TNT, adverse health effects would not be expected to occur in the most sensitive members of the US population. The surrogate for the most sensitive member is the 10 kg child, imbibing 1 L of water/day. The reports and studies reviewed in this text do not provide sufficient detail to determine 1-day and 10-day health advisories. (Lantz-PTT)
W90-01716

**ALGAE FLUORESCENCE TEST AS A SENSITIVE BIOTEST ON ALGICIDE SUBSTANCES IN SURFACE WATER (ALGEN-FLUORESZENZTEST ALS EMPFINKLICHER BIOTEST AUF ALGIZIDE SUBSTANZEN IM OBERFLAECHENWASSER).**
Umweltbundesamt, Berlin (Germany, F.R.).
C. Schmidt.
Available from National Technical Information Service, Springfield, VA 22161 as TIB/A88-80882/GAR. Price codes: E07 in paper copy. Report 34/85, September 1985. 32p, 20 fig, 3 tab, 25 ref. In German.

Descriptors: *Monitoring, *Algicides, *Algal control, Cultures, Fluorescence, Water pollution effects.

The algae fluoscence test was developed as a biological test process for water quality monitoring, which makes the continuous measurement of the

fluorescence of an algae suspension possible. An algae culture with single cell green algae is used, which is kept at constant density by a chemostat. If harmful substances like trichlorethylene or perylene are added to the water sample, the fluorescence is reduced by damage to the chlorophyll or by the effect of the algicide substances on artificial electron acceptors. After a harmful substance is added, there is always a delay in fluorescence. The algae fluorescence test is suitable as a quick process for measuring the first effects locally, as most algicide harmful substances act as poisons to photosynthesis. (Author's Abstract)
W90-01730

**GC/MS IDENTIFICATION OF MUTAGENS IN AQUEOUS CHLORINATED HUMIC ACID AND DRINKING WATERS FOLLOWING HPLC FRACTIONATION OF STRONG ACID EXTRACTS.**
Environmental Protection Agency, Cincinnati, OH.
For primary bibliographic entry see Field 5F.
W90-01759

**APPLICATION OF CLOSED LOOP STRIPPING AND XAD RESIN ADSORPTION FOR THE DETERMINATION OF OZONE BY-PRODUCTS FROM NATURAL WATER.**
California Univ., Los Angeles.
For primary bibliographic entry see Field 5F.
W90-01766

**APPLICATION OF GENE PROBES TO THE DETECTION OF ENTEROVIRUSES IN GROUNDWATER.**
Arizona Univ., Tucson. Dept. of Microbiology and Immunology.
A. B. Margolin, K. J. Richardson, R. DeLeon, and C. P. Gerba.
IN: Biohazards of Drinking Water Treatment, Lewis Publishers, p 265-270, 1989. 4 tab, 9 ref.

Descriptors: *Gene probes, *Plasmids, *Genetic engineering, *Pollutant identification, *Groundwater pollution, *Viruses, *Human pathogens, Human diseases, Water quality, Water quality control, Potable water, Drinking water, Microorganisms.

An experiment was conducted to test the use of gene probes to detect enteric viruses in water. Poliovirus type 1 (LSc) and Hepatitis A virus (enterovirus type 72) were grown and assayed. The gene probes were labeled with 32P dCTP and 32P dATP. The entire plasmid along with the viral cDNA insert was used as the probe. Results were visualized by autoradiography for 24-36 h at minus 70 C. The poliovirus and hepatitis A virus were detected in seeded tap water with sensitivities equal to the PFU and RIFA assays. These results show the development of a cDNA probe capable of detecting as few as 1 PFU of poliovirus or 1 RIFA unit of hepatitis A virus within 72 h. Beef extract, which was used to elute viruses from filters, did not seem to interfere with the sensitivity of the assay nor did it create false positive results. The gene probe assay does not first require virus growth in cell culture. This allow samples to be probed directly and decreases the assay time. It also allows for the detection of viruses that may not be infectious, but still retain their genome. Untreated groundwater should not contain any viruses, hence the gene probe assay can be used as a rapid assay to determine if a sample is contaminated with viruses. The gene probe was a reliable, sensitive assay. (See also W90-01750) (Friedmann-PTT)
W90-01771

**APPLICATIONS OF OPTICAL EMISSION SPECTROSCOPY WITH INDUCTIVELY HEATED ARGON PLASMA TORCH IN THE ANALYSIS OF ENVIRONMENTAL MATERIALS (UNTERSUCHUNGEN ZU EINSATZMOGLICHKEITEN DER OPTISCHEN EMISSIONS-SPEKTROMETRIE MIT INDUKTIV GEHEIZTER ARGONPLASMAFACKEL BEI DER ANALYSE VON UMWELTPROBEN).**
GKSS - Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.)
W. Berneike.
Available from National Technical Information Service, Springfield, VA 22161 as DE88752640/GAR, Price codes: A08 in paper copy, A01 in microfiche. Report GKSS-87/E/36, 1987. 172p, 79 fig, 19 tab, 71 ref. English summary.

Descriptors: *Water analysis, *Emission spectroscopy, *Chemical analysis, Manganese, Lead, River Elbe, Nutrients.

The application of inductively coupled plasma atomic emission spectrometry as a method for the quantitative analysis of elements in environmental samples is described. Systematic investigations were undertaken using a sequentially working ICP device to optimize working parameters, determine plasma temperatures and to recognize spectral interferences. The performance of a simultaneous system equipped with 32 element channels is also described. Solid samples were digested under pressure using inorganic acids, and the resulting fluids were analyzed by ICP. Results for manganese and lead concentrations in the water from the river Elbe, and the nutrient content and toxic elements present in spruce from different sites are discussed. (Author's Abstract)
W90-01773

**INSTRUMENTATION AND SAMPLING METHODS FOR THE SIMPLE CONTROL OF OUTLETS TO AIR AND WATER (INSTRUMENTERING OG PROVETAKING VED ENKEL KONTROLL AV UTSLIPP TIL LUFT OG VANN).**
For primary bibliographic entry see Field 7A.
W90-01774

**DEVELOPMENT AND EXAMPLE OF USE OF A PROCESS FOR ADEQUATE QUANTIFICATION OF QUALITY OF WATER COURSES (ENTWICKLUNG UND EXEMPLARISCHE ANWENDUNG EINES VERFAHRENS ZUR NUTZUNGSADAEQUATEN QUANTIFIZIERUNG VON GEWAESSERGUETE).**
Technische Hochschule Aachen (Germany, F.R.). Fakultaet fuer Bauingenieur- und Vermessungswesen.
P. Doetsch.
Available from National Technical Information Service, Springfield, VA 22161 as TIB/B88-80904/GAR, Price codes: E99 in paper copy. July 10, 1986. 450p, 85 fig, 63 tab, 395 ref.

Descriptors: *Water quality, *Water analysis, *Water chemistry, *Water quality standards, *Chemical analysis, Water pollution control, Quantification, Biological properties, Chemical properties, Water quality control, Water quality management, Physiology.

An attempt is based on use analysis to operationalize the theoretical term 'quality of water courses' because the biological-ecological processes physiological processes and the chemical and physical water parameters are not sufficient for the complex tasks of quantifying water quality. A newly developed process for determining adequate water quality indices (potential state, quality potential, value synthesis standardization) are explained and this new process is made concrete (load of flowing water, investigation parameter of water monitoring, national and international emission values). Finally, the possibilities and limits of this developed water quality quantification process are shown. (Author's Abstract)
W90-01783

**SUPRA-NATIONAL MAPPING OF ENVIRONMENTAL NUISANCES BY POLLUTANTS (UEBERREGIONALES KATASTER DER SCHADSTOFFBELASTUNG DES BODENS).**
Umweltbundesamt, Berlin (Germany, F.R.).
G. Allnoch, G. Gieseler, H. Hanke, and H. G. Nolte.
Available from National Technical Information Service, Springfield, VA 22161 as TIB/B87-06208, Price codes: E11 in paper copy. Contract UFO-PLAN-Nr. Report UBA-FB-84-113. December 1985. 125p, 30 fig, 25 tab, 104 ref. English summary.

Descriptors: *Soil contamination, *Soil chemistry, *Soil properties, *Groundwater pollution, *Groundwater management, Sensitivity, Risks, Mapping, Water pollution control.

A method was studied for differentiating between soils according to their sensitivity to selected chemicals (heavy metals, acids, persistent organic chemicals) and of evaluating the relative pollution of the soil and ground water by these substances from the information available. By comparing soil pollution and soil sensitivity, areas where soils and groundwater are at risk can be identified. Soil sensitivity is ascertained by using the soil map 1:1000,000. As a basis for pollution the socio-economic structure (household, industry/power stations, agriculture) is utilized. (Author's Abstract)
W90-01790

**WARNING SYSTEM COMPATIBLE WITH RANDOMLY TIMED POLAR SATELLITES: DEVELOPMENT ALTERNATIVES FOR OIL SPILL WARNING SYSTEMS.**
Vizgazdalkodasi Tudomanyos Kutato Intezet, Budapest (Hungary).
For primary bibliographic entry see Field 7B.
W90-01822

## 5B. Sources Of Pollution

**EFFECT OF SERIAL CORRECTION ON GROUNDWATER QUALITY SAMPLING FREQUENCY.**
Department of Scientific and Industrial Research, Christchurch (New Zealand). Geophysics Div.
For primary bibliographic entry see Field 7A.
W90-00964

**MODELING OF LEAKAGE THROUGH CRACKED CLAY LINERS--I: STATE OF THE ART.**
Wayne State Univ., Detroit, MI. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5E.
W90-00969

**MODELING OF LEAKAGE THROUGH CRACKED CLAY LINERS--II: A NEW PERSPECTIVE.**
Wayne State Univ., Detroit, MI. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5E.
W90-00970

**EFFECTS OF FOREST HERBICIDE APPLICATIONS ON STREAMWATER CHEMISTRY IN SOUTHWESTERN BRITISH COLUMBIA.**
British Columbia Univ., Vancouver. Faculty of Forestry.
For primary bibliographic entry see Field 5C.
W90-00976

**EFFECT OF SULFOMETURON METHYL ON GROUND WATER AND STREAM QUALITY IN COASTAL PLAIN FOREST WATERSHEDS.**
Southeastern Forest Experiment Station, Gainesville, FL.
D. G. Neary, and J. L. Michael.
Water Resources Bulletin WARBAQ, Vol. 25, No. 3, p 617-623, June 1989. 4 fig, 1 tab, 27 ref.

Descriptors: *Path of pollutants, *Groundwater quality, *Streams, *Forest management, *Herbicides, *Sulfometuron methyl, *Forest watersheds, Sediments, Sampling.

Sulfometuron methyl was applied by a ground sprayer at a maximum labeled rate of 0.42 kg/ha a.i. to a 4 ha Coastal Plain flatwoods watershed as site preparation for tree planting. Herbicide residues were detected in streamflow for only seven days after treatment and did not exceed 7 mg/cu

m. Sulfometuron methyl was not detected in any streamflow and was not found in any sediment (both bedload and suspended). Sampling of a shallow. groundwater aquifer, < 1.5 m below ground surface, did not detect any sulfometuron methyl residues for 203 days after herbicide application. Lack of herbicide residue movement was attributed to low application rates, rapid hydrolysis in acidic soils and water, and dilution in streamflow. (Author's abstract)
W90-00977

**KALMAN FILTER CALCULATIONS OF SAMPLING FREQUENCY WHEN DETERMINING ANNUAL MEAN SOLUTE CONCENTRATIONS.**
Colorado State Univ., Fort Collins. Dept. of Earth Resources.
For primary bibliographic entry see Field 7A.
W90-00983

**WATER QUALITY AND MACROINVERTEBRATE POPULATIONS BEFORE AND AFTER A HAZARDOUS WASTE CLEANUP.**
Ball State Univ., Muncie, IN. Dept. of Natural Resources.
For primary bibliographic entry see Field 5G.
W90-00984

**TECHNICAL POLYMERS AS WASTE WATER COMPONENTS. WATER CONTAMINATION BY TEXTILE SIZING AGENTS (TECHNISCHE POLYMERE ALS ABWASSERINHALTSSTOFFE. GEWASSERBELASTUNG DURCH SCHLICHTEMITTEL DER TEXTILINDUSTRIE).**
Eidgenoessische Materialpruefungs- und Versuchsanstalt fuer Industrie, Bauwesen und Gewerbe, St. Gall (Switzerland).
V. W. Schefer, and K. Romanin.
Journal for Water and Wastewater Research ZWABAQ, Vol. 22, No. 4, p 157-164, 1989. 7 fig, 1 tab, 10 ref. English summary.

Descriptors: *Water pollution sources, *Industrial wastes, *Textile mill wastes, *Polymers, Organic carbon, Chemical oxygen demand, Oxygen demand, Biodegradability.

Textile warp sizing agents based on organic polymers are an important source of water contamination by 'refractory carbon'. By appropriate testing, especially of biodegradability, ecologically hazardous products can be distinguished from harmless ones. Evaluation of test results is facilitated by combining several parameters such as dissolved organic carbon (DOC), chemical oxygen demand (COD), and oxygen consumption. In some cases a simulation test in a continuously operating laboratory plant for sewage treatment is advisable. In more recently developed (natural and artificial) products inherent biodegradability is significantly improved. It is suggested that the ecological problems caused by textile waste waters might be considerably lowered if sizing agents or blends thereof showed a biodegradability of 80% or more, tested by the OECD guideline 302 B during 14 days. (Author's abstract)
W90-00987

**ANAEROBIC BIODEGRADATION OF POLYCHLORINATED BIPHENYLS IN HUDSON RIVER SEDIMENTS AND DREDGED SEDIMENTS IN CLAY ENCAPSULATION.**
New York State Dept. of Health, Albany. Wadsworth Center for Labs. and Research.
G.-Y. Rhee, B. Bush, M. P. Brown, M. Kane, and L. Shane.
Water Research WATRAG, Vol. 23, No. 8, p 957-964, August 1989. 9 fig, 29 ref. Hudson River Foundation (02186B015).

Descriptors: *Fate of pollutants, *Biodegradation, *Polychlorinated biphenyls, *Sediments, *Biodegradation, Hudson River, Arochlor, Carbon dioxide, Nitrogen, Hydrogen, Anaerobic digestion.

Anoxic Hudson River sediments and clay-encapsulated dredged sediments were investigated to determine whether anaerobic biodegradation of polychlorinated biphenyls (PCBs) occurred. Measured as a decrease in congener concentrations, clear evidence for anaerobic biodegradation of ambient PCBs was found in untreated Hudson River sediments incubated in the laboratory under an N2 atmosphere. Of 10 different sediment treatments, which included amendments with biphenyl, yeast extract/trypticase mixture, live and sterilized anaerobic sewage sludges and inoculation with a mixed culture obtained with Aroclor 1221 enrichment, under either an N2 or CO2/H2 atmosphere, biphenyl enrichment in N2 was most effective for both sediments. About 53% of the total PCBs (375 mg/kg sediment dry wt), mainly monochlorobiphenyls to pentachlorobiphenyls, was degraded in the biphenyl-amended Hudson River sediments and 30% (281 mg/kg sediment) in biphenyl-amended Moreau sediments after 7 months, with the spectrum of congeners degraded much broader in Hudson River than Moreau sediments. Biphenyl amendment enhanced the disappearance of highly chlorinated congeners. Inoculation with the mixed culture showed positive results in Moreau sediments but not in Hudson River sediments. Regardless of treatments, no biodegradation occurred in CO2/H2 atmosphere. Moreau sediments incubated in situ (from November to June), showed little change in congener concentrations in all treatments, suggesting temperature as an important factor. The accumulation of less-chlorinated congeners as a result of reductive dechlorination of highly chlorinated ones was not observed. (Author's abstract)
W90-00993

**DETERMINATION OF ORGANOCHLORINE PESTICIDES IN INDIAN COASTAL WATER USING A MOORED IN-SITU SAMPLER.**
National Inst. of Oceanography, Panaji (India). Chemical Oceanography Div.
A. Sarkar, and S. Gupta.
Water Research WATRAG, Vol. 23, No. 8, p 975-978, August 1989. 3 fig, 2 tab, 15 ref.

Descriptors: *Water pollution sources, *Water quality, *Pesticides, *Lindane, *DDT, *Aldrin, *Dieldrin, *India, Residues, Water chemistry, Metabolites.

Residues of various organochlorine pesticides were determined in the water off the central west coast of India using an in-situ sampler. Lindane and the two cyclodiene compounds, Aldrin and Dieldrin were found to be more consistent than the DDT family. Lindane ranged from 0.26 to 9.4 ng/L whereas Aldrin and Dieldrin were from 1.4 to 9.8 and 2.1 to 50.9 ng/L, respectively. Among the compounds of the DDT family, pp-DDT was found to be more abundant than the others in the southern part of the region, whereas op-DDT was present in a fairly considerably amount off Ratnagiri coast. Among the metabolites of DDT, pp-DDE was found to be present in every alternate station with increasing concentration (2.5-20.30 ng/L) whereas op-DDE could be detected occasionally in the northern part of the region. Presence of op-DDD was observed only in one sample off the Ratnagiri coast, whereas pp-DDD was not detected at all. (Author's abstract)
W90-00995

**STOCHASTIC PHOSPHOROUS MODEL FOR ONONDAGA LAKE.**
Michigan Univ., Ann Arbor. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2H.
W90-01000

**NATURE AND EXTENT OF GROUNDWATER CONTAMINATION BY PESTICIDES IN AN AGRICULTURAL WATERSHED.**
Agricultural Research Service, University Park, PA. Northeast Watershed Research Center.
H. B. Pionke, and D. E. Glotfelty.
Water Research WATRAG, Vol. 23, No. 8, p 1031-1037, August 1989. 4 fig, 3 tab, 20 ref.

Descriptors: *Groundwater pollution, *Pennsylvania, *Pesticides, *Wells, *Springs, *Nitrates, *Phosphates, Chlorine, Groundwater recharge, Atrazine, Alachlor, Metolachlor, Carbofuran, Terbufos, Chlorpyrifos, Fonofos, Simazine, Cyanazine, Corn, Cropland.

Waters from 21 wells and two springs located in a typically farmed, mostly agricultural Pennsylvania watershed were analyzed for 11 pesticides, NO3, Cl and PO4. Among the pesticides selected according to a farm use survey, only atrazine was commonly found but at extremely low concentrations ranging from 3 ng/L to 1.11 microgram/L. Atrazine appeared in 74% of cropland wells at least once in a three sampling sequence designed to sample several major groundwater recharge periods. No alachlor, metolachlor, carbofuran, terbufos, chlorpyrifos, or fonofos was found. Cyanazine was found intermittently in two wells. With only one record of application, simazine was found at least once in 32% of the cropland wells, but at extremely low concentrations. Neither 2,4-D nor dicamba were found in the one sampling analyzed. The frequency and extent of corn production expressed as Corn Production Intensity (CPI) was strongly related to atrazine concentrations. The highest atrazine concentrations were nearly always associated with continuous corn production. Atrazine concentrations over time varied greatly by well and followed several distinct patterns. Sampling time relative to major groundwater recharge periods affected these concentrations, but a predictive relationship was not apparent. (Author's abstract)
W90-01003

**INFERRING PH FROM DIATOMS: A COMPARISON OF OLD AND NEW CALIBRATION METHODS.**
Instituut TNO voor Wiskunde, Informatieverwerking en Statistiek, Wageningen (Netherlands).
For primary bibliographic entry see Field 5A.
W90-01015

**EFFECTS OF PARAMETER UNCERTAINTY ON PREDICTIONS OF UNSATURATED FLOW.**
Virginia Polytechnic Inst. and State Univ., Blacksburg. Center for Environmental and Hazardous Material Studies.
For primary bibliographic entry see Field 2G.
W90-01018

**INFILTRATION, SOIL MOISTURE, AND RELATED MEASUREMENTS AT A LANDFILL WITH A FRACTURED COVER, ILLINOIS.**
Northern Illinois Univ., De Kalb. Dept. of Geology.
For primary bibliographic entry see Field 5E.
W90-01024

**SEEPAGE THROUGH A HAZARDOUS-WASTE TRENCH COVER.**
Geological Survey, Denver, CO.
R. W. Healy.
Journal of Hydrology JHYDA7, Vol. 108, No. 1-4, p 213-234, Jun 1989. 10 fig, 4 tab, 43 ref.

Descriptors: *Landfills, *Landfill covers, *Underground waste disposal, *Radioactive waste disposal, *Seepage, *Soil water, *Groundwater pollution, *Path of pollutants, Trenches, Darcy method, Water budget methods, Hydraulic conductivity, Illinois.

Water movement through a waste-trench cover under natural conditions at a low-level radioactive waste disposal site in northwestern Illinois was studied from July 1982 to June 1984, using tensiometers, a moisture probe, and meteorological instruments. Four methods were used to estimate seepage: the Darcy, zero-flux plane, surface-based water-budget, and groundwater-based water-budget methods. Annual seepage estimates ranged from 48-216 mm (5-23% of total precipitation), with most seepage occurring in spring. The Darcy method, although limited in accuracy by uncertainty in hydraulic conductivity, was capable of discretizing seepage in space and time and indicated that

seepage rates varied by almost an order of magnitude across the width of the trench. Lowest seepage rates occurred near the center of the cover, where seepage was gradual. Highest rates occurred along the edge of the cover, where seepage was highly episodic, with 84% of the total there being traced to wetting fronts from 28 individual storms. Limitations of the zero-flux method were severe enough for the method to be judged inappropriate for use in this study. (Author's abstract)
W90-01026

**EARLY SMELTER SITES: A NEGLECTED CHAPTER IN THE HISTORY AND GEOGRAPHY OF ACID RAIN IN THE UNITED STATES.**
Nebraska Wesleyan Univ., Lincoln.
M. L. Quinn.
Atmospheric Environment ATENBP, Vol. 23, No. 6, p 1281-1292, Jun 1989. 4 fig, 100 ref.

Descriptors: *Acid rain, *Smelters, *Water pollution sources, *History, *Air pollution, Tennessee.

Dominant spatial and temporal theories of acid rain in the U.S. are identified, followed by brief comments on how historical data have generally been used in modern acid rain research. A frequently-cited 1982 article by E. B. Cowling is examined, one that has influenced much thinking on the history of the acid rain. The article overlooks early American smelters, however, and the role they played in the true history and geography of acid rain in the United Sates. Continuing with this theme, a connection is established between acid rain and the turn-of-the-century smelter smoke problems. Literature on the smelter smoke subject is discussed, and American and German examples are given. A beginning is then made on writing acid rain's neglected chapter, focusing on Tennessee's Copper Basin (Ducktown District) where copper smelting dates back to the 1860's. A short historical overview of this area's smelting operation is given, with particular attention to the air pollution and other environmental problems resulting from large emissions of sulfur dioxide. Five additional early smelter sites in Montana, Utah, California, and Canada for potential study are mentioned as well. Some observations are given regarding the way in which expanded research of early smelter sites could affect the general perception of acid rain in the U.S. It is also suggested that such research might contribute to a better atmosphere for making decisions and policies pertaining to the phenomenon as it exists today. (Author's abstract)
W90-01060

**STUDIES ON NON-PRECIPITATING CUMULUS CLOUD ACIDIFICATION.**
Kentucky Univ., Lexington. Dept. of Chemical Engineering.
S. K. Nair, and L. K. Peters.
Atmospheric Environment ATENBP, Vol. 23, No. 6, p 1399-1423, June 1989. 20 fig, 5 tab, 59 ref.

Descriptors: *Acid rain, *Water pollution sources, *Clouds, *Model studies, Cloud physics, Cloud liquid water, Chemical reactions, Sulfur, Sulfuric acid, Ozone, Hydrogen ion concentration, Chlorides.

A one-dimensional cumulus cloud model was used to study the chemical transformation occurring during the formation, growth and dissipation of a cloud. A parabolic vertical velocity profile is introduced to create an updraft which entrains and detrains air laterally. The cloud forms in the upper half of the updraft structure where lateral detrainment occurs, all entrainment being from below the cloud base. As the updraft velocity increases in magnitude, the cloud grows and deepens. Downdraft is introduced into the fully developed cloud so that lateral entrainment into the parcel is from regions above cloud top. The cloud dissipates and eventually disappears as the downdraft penetrates and reaches the cloud base. Predicted liquid water contents and cloud structure are consistent with field observations. Detailed gas-and-aqueous-phase chemistries are included in the cloud model. First-order rate constants for the oxidation of S(IV) to S(VI) increase with increasing concentrations of H2O2 in the background and with increasing cloud water content. The cloud water pH depends primarily on the degree of oxidation of S(IV) to S(VI) by H2O2 which is the most important oxidant of S(IV) in the aqueous phase. HO2, OH, Cl(--), and the intermediate SO4 also make significant contributions to the oxidation, while for these runs, O3 contributes less than 2% to the overall oxidation. Cumulus clouds behave like large variable volume reactors with entrainment of background air from below-cloud regions and release of processed air from in-cloud regions. The first-order rate constant for the oxidation of S(IV) to S(V) ranges from 1%/min to 33%/ min, depending on cloud properties and trace species concentrations. (Author's abstract)
W90-01061

**TRIBUTYLTIN IN SYDNEY HARBOUR AND GEORGES RIVER WATERS.**
Commonwealth Scientific and Industrial Research Organization, Lucas Heights (Australia). Lucas Heights Research Labs.
G. E. Batley, K. J. Mann, C. I. Brockbank, and A. Maltz.
Australian Journal of Marine and Freshwater Research AJMFA4, Vol. 40, No. 1, p 39-48, 1989. 1 fig, 2 tab, 30 ref.

Descriptors: *Tributyltin, *Tin compounds, *Pollutant identification, *Pesticides, *Antifoulants, *Water pollution sources, *Sydney Harbor, *Georges River, Estuaries, Water analysis, Boating, Antifouling paints, Gas chromatography, Chromatography.

Water from 23 sites in Sydney Harbor and the Georges River estuary (New South Wales) have been analyzed for tributyltin (TBT) using gas chromatography with electron capture detection, after solvent extraction as the hydride. Analytical data for TBT in Sydney waters are consistent with other data reported for overseas estuaries, with the majority of samples containing less than 45 ng Sn/L as TBT. Samples from areas of high boating activity such as Rushcutters Bay and Garden Island had the highest TBT concentrations at 90-190 ng Sn/L. The mean ambient TBT concentration in each estuary was computed using a tidal prism model. Despite the broad assumptions made, calculated results agreed well with those measured at sites with no obvious local point source of TBT. (Author's abstract)
W90-01067

**ACCUMULATION OF TRIBUTYLTIN BY THE SYDNEY ROCK OYSTER, SACCOSTREA COMMERCIALIS.**
Commonwealth Scientific and Industrial Research Organization, Lucas Heights (Australia). Lucas Heights Research Labs.
G. E. Batley, C. Fuhua, C. I. Brockbank, and K. J. Flegg.
Australian Journal of Marine and Freshwater Research AJMFA4, Vol. 40, No. 1, p 49-54, 1989. 1 fig, 2 tab, 11 ref.

Descriptors: *Pesticides, *Antifoulants, *Bioaccumulation, *Crustaceans, *Organotin compounds, *Boating, *Water pollution effects, Tidal flushing, Oysters, Tissue analysis, Water analysis, Estuaries, Australia.

Tributyltin (TBT) concentrations have been measured in the tissue of the Sydney rock oyster Saccostrea commercialis sampled from estuaries in New South Wales, Australia. Background TBT levels of below 2 ng Sn/g contrasted with values between 80 and 130 ng Sn/g in oysters exposed to high boat densities or poor tidal flushing. Shell deformities and reduced tissue weights were associated with all samples displaying elevated TBT levels. Specimens of the Pacific oyster, Crassostrea gigas, growing on the same racks displayed 2-3 times the TBT concentrations of S. commercialis. (Author's abstract)
W90-01068

**EXPERIMENTAL ASSESSMENT OF RATES OF NITRATE REMOVAL BY RIVER BED SEDIMENTS.**
M. Wyer, and D. Kay.
Journal of the Institution of Water and Environmental Management, Vol. 3, No. 3, p 273-279, June 1989. 6 fig, 2 tab, 13 ref.

Descriptors: *Fate of pollutants, *Self-purification, *Nitrates, *Denitrification, *River beds, *Sediment-water interfaces, Flow, Incubation, Chlorides, Sulfates, Ammonia, Potassium, Temperature, Particle size, Navigation, Flood channels, River basins, Ecosystems, Raw water, Nitrogen cycle.

Concentrations of chloride, nitrate-N, sulfate, sodium, ammoniacal-N, and potassium were monitored for six days in 20 riverine sediment-water flow tank experiments. The results agree with orders of magnitude recorded for nitrate removal rates in previous studies. However, the present study has incorporated flowing water into incubations and allowed sizable portions of stream bed, including composite and cobble beds, to be incubated. Also, significant sedimentary nitrate removal has been detected at low nitrate-N concentrations of two milligrams per liter. Actual removal rates in the river, for any given temperature, would be higher due to the constant flow of nitrate-laden water over the sediment profile. The results suggest that nitrate removal rates may be enhanced by maintaining reaches containing fine-textured sediments. At present river beds are managed for navigation and flood alleviation, by straightening and sedimentary removal. This removes a potential source of material which is capable of dissimilating nitrate from stream waters, and may significantly reduce the nitrate removal potential of a river basin. It is suggested that there are management possibilities for stream bed ecosystems and raw water impoundments with respect to nitrogen cycling. (Fish-PTT)
W90-01095

**UTILIZATION OF WASTE-GROWN ALGAE FOR FEEDING FRESHWATER SHRIMPS.**
Hong Kong Baptist Coll., Kowloon. Dept. of Biology.
For primary bibliographic entry see Field 5E.
W90-01103

**THINKING ABOUT NONPOINT SOURCES OF WATER POLLUTION AND SOUTH DAKOTA AGRICULTURE.**
For primary bibliographic entry see Field 5G.
W90-01105

**SURVIVAL OF AND PLASMID STABILITY IN PSEUDOMONAS AND KLEBSIELLA SP INTRODUCED INTO AGRICULTURAL DRAINAGE WATER.**
Guelph Univ. (Ontario). Dept. of Environmental Biology.
J. T. Trevors, J. D. van Elsas, M. E. Starodub, and L. S. Van Overbeek.
Canadian Journal of Microbiology CJMIAZ, Vol. 35, No. 7, p 675-680, July 1989. 1 fig, 4 tab, 23 ref.

Descriptors: *Path of pollutants, *Pseudomonas, *Klebsiella, *Wastewater, *Drainage water, *Plasmids, Bacteria, Farm wastes.

Cell survival and plasmid stability in Pseudomonas fluorescens R2f and Pseudomonas putida CYM 318 containing respectively, plasmid RP4 and pRK2501, and Klebsiella aerogenes NCTC 418 harboring plasmid pBR322 were studied in sterile and nonsterile agricultural drainage water under both aerobic and anaerobic conditions and in the absence and presence of added nutrients. Both Pseudomonas strains survived well in sterile drainage water incubated aerobically, with or without added nutrients. However, Klebsiella aerogens NCTC 418(pBR322) did not survive under anaerobic conditions without added nutrients, but showed good survival in the presence of nutrients. Survival of all three strains was negatively affected in nonsterile agricultural drainage water when compared with survival in sterile water. Maintenance of the

three plasmids was host, plasmid, and environment dependent. Plasmid pBR322 was not stably maintained in K. aerogenes NCTC 418 under all conditions used in the study, and pRK2501 was readily lost from P. putida CYM 318. Maintenance of RP4 by P. fluorescens R2f was markedly influenced by added nutrients, which caused a loss of the plasmid from cells, The results of the present study demonstrate the influence of nutrients, oxygen, and native microorganisms on the survival of introduced bacterial strains and plasmid stability in agricultural drainage water. (Author's abstract)
W90-01110

**REGIONAL GEOCHEMISTRY OF METAL-CONTAMINATED SURFICIAL SEDIMENTS AND SEAGRASSES IN UPPER SPENCER GULF, SOUTH AUSTRALIA.**
Commonwealth Scientific and Industrial Research Organization, Glen Osmond (Australia). Div. of Soils.
K. G. Tiller, R. H. Merry, B. A. Zarcinas, and T. J. Ward.
Estuarine, Coastal and Shelf Science ECSSD3, Vol. 28, No. 5, p 473-493, May 1989. 7 fig, 6 tab, 41 ref.

Descriptors: *Water pollution sources, *Geochemistry, *Australia, *Heavy metals, *Lead, *Zinc, *Cadmium, *Arsenic, *Sea grasses, Posidonia, Germein Bay, Tidal currents, Sediments, Smelters.

Surfical sediments, shallow sediment cores and seagrass samples were collected over an area of about 600 square km of upper Spencer Gold, South Australia, adjacent to a major lead-zinc smelter. Regional variation in heavy metal contents was studied in relation to different pathways of contamination from the smelter complex, and geochemical association with natural constituents of the sediments. About 300 square km were contaminated to some extent. Areas of appreciable contamination (10 times background) were greatest for Cd and least for As, with Pb and Zn intermediate. Regional trends of heavy metals in the sediment reflected inputs of pollutants from both liquid effluents and atmospheric fallout, modified by tidal currents. Total accessions to Germein Bay were estimated to be at least 25,000 tons each of Pb and Zn and 500 tons of Cd and As. Arsenic differed both in its distribution with sediment depth and in its geochemical associations when compared to Pb, Zn and Cd. Correlation of Cd with the fine fraction (less than 20 micrometers) permitted a normalization of data which accounted for marked regional variations in sediment grain size and provided a better basis of assessing the regional impact of pollution. Metal concentrations in Posidonia leaves were highly correlated with total and EDTA extractable metal concentrations in the sediments, and may provide a more sensitive indicator of metal dispersion. Background levels of metals in Posidonia were not found in our study area. (Author's abstract)
W90-01115

**METALLIC BIOACCUMULATION IN AQUATIC PLANTS (BIOACCUMULATION DES METAUX DANS LES VEGETAUX AQUATIQUES).**
Ecole Nationale Superieure de Geologie Appliquee et de Prospection Miniere, Nancy (France). Centre de Valorisation des Minerais.
For primary bibliographic entry see Field 5A.
W90-01143

**HEAVY METAL POLLUTION IN GOMTI RIVER SEDIMENTS AROUND LUCKNOW, UTTAR PRADESH.**
Lucknow Univ. (India). Dept. of Geology.
S. Kumar.
Current Science CUSCAM, Vol. 58, No. 10, p 557-559, May 20, 1989. 2 fig, 2 tab, 3 ref.

Descriptors: *Heavy metals, *India, *Water pollution sources, *Gomti River, Copper, Manganese, Lead, Chromium, Phosphates, Zinc, Water pollution, Pollutant identification, Colorimetry.

Eight bank mud samples were collected from a stretch of 9 km of Gomti river in March 1987. Treated samples were evaluated on a Elko II colorimeter with an S42 E (418nm) filter. The Clay fraction (less than 2 micrometers) of Gomti river sediments showed relatively higher values for Cu, Mn, Pb, Cr and PO4 in comparison to background values. Fe, Co and Ni did not show any increase and Cd was not within detectable limits. PO4 showed very good positive correlation with Cu, Pb, Zn and Mn. It was concluded that municipal waste discharged into the river through drains was responsible for the higher values of heavy metals and PO4, but in general Gomti river sediments can be termed as unpolluted with heavy metals. (Mertz-PTT)
W90-01147

**SANDOZ SPILL: THE FAILURE OF INTERNATIONAL LAW TO PROTECT THE RHINE FROM POLLUTION.**
California Univ., Berkeley. School of Law.
For primary bibliographic entry see Field 5G.
W90-01149

**IMPACT OF ATMOSPHERIC DEPOSITION ON THE AQUATIC ECOSYSTEM WITH SPECIAL EMPHASIS ON LAKE PRODUCTIVITY, NEWFOUNDLAND, CANADA.**
Areco Canada, Inc., Ottawa (Ontario).
For primary bibliographic entry see Field 5C.
W90-01151

**HIGH-RESOLUTION PROFILES OF TEMPERATURE AND DISSOLVED OXYGEN IN A RIVER.**
Queensland Univ., Brisbane (Australia). Dept. of Physics.
For primary bibliographic entry see Field 7C.
W90-01152

**OCCURRENCE OF RADON, RADIUM, AND URANIUM IN GROUNDWATER.**
Environmental Protection Agency, Cincinnati, OH.
For primary bibliographic entry see Field 2K.
W90-01162

**TOXICOKINETICS AND TOXICODYNAMICS OF PYRETHROID INSECTICIDES IN FISH.**
Environmental Research Lab.-Duluth, MN.
For primary bibliographic entry see Field 5C.
W90-01175

**EPA'S PESTICIDES IN GROUNDWATER STRATEGY: WILL IT WORK.**
Beveridge and Diamond, Washington, DC.
For primary bibliographic entry see Field 5G.
W90-01191

**SOLUBLE POTASSIUM TRANSPORT IN AGRICULTURAL RUNOFF WATER.**
Agricultural Research Service, Durant, OK. Water Quality and Watershed Research Lab.
A. N. Sharpley, S. J. Smith, and L. R. Ahuja.
Agricultural Water Management AWMADF, Vol. 15, No. 1, p 37-46, November 1988. 4 fig, 3 tab, 18 ref.

Descriptors: *Nonpoint pollution sources, *Water pollution sources, *Agricultural hydrology, *Potassium, *Soil water, *Agricultural runoff, Mathematical studies, Rainfall-runoff relationships, Runoff, Surface water, Kinetics, Rainfall intensity, Soil erosion.

Potassium transport in runoff from three agricultural soils was investigated in laboratory and field experiments using a kinetic equation describing soil K desorption. In the laboratory, this equation was used to study the effect of rainfall intensity and soil slope, cover, and residue incorporation on the effective depth of interaction between surface soil and runoff (EDI), and important parameter in the kinetic equation. Using simulated rainfall, EDI increased linearly (from 1.6 to 22.0 mm) with an increase in rainfall intensity (50 to 160 mm/h) and soil slope (2 to 20%). EDI was reduced an average 82% following incorporation of 5.0 t/ha of wheat straw (Triticum aestivum L. sp.) and 44% by a 0.5 sq mm mesh screen, simulating crop cover, compared to the control (4.5 mm). This reduction was attributed to a decreased turbulent mixing of water at the soil surface brought about by an increased physical protection of soil. For all soils and treatments, EDI was logarithmically related to soil loss (r squared + = 0.80), allowing estimation of EDI under variable rainfall intensity, soil slope, type, and cover conditions from measured or estimated soil loss. The values of EDI, thus estimated, were used in the kinetic equation to predict solution K transport in runoff from eight agricultural watersheds in Oklahoma. Measured and predicted mean annual flow-weighted concentrations of solution K were not significantly different and were strongly correlated (r squared = 0.92). These results improve our capability to predict K transport in runoff under field conditions. These methods could also be applied to other agricultural chemicals transported in runoff and results used to improve management of soil and water. (Author's abstract)
W90-01220

**PHARMACOKINETIC ANALYSIS OF THE EFFECT OF TEMPERATURE ON THE ACCUMULATION OF DI-2-ETHYLHEXYL PHTHALATE (DEHP) IN SHEEPSHEAD MINNOW.**
Northeast Louisiana Univ., Monroe. School of Pharmacy.
A. H. Karara, and W. L. Hayton.
Aquatic Toxicology AQTODG, Vol. 15, No. 1, p 27-36, July 1989. 6 fig, 1 tab, 16 ref. NIH grant ESO1995 and EPA grant R812818.

Descriptors: *Path of pollutants, *Fish, *Temperature effects, *Bioaccumulation, *Tissue analysis, *Accumulation, Phthalates, Rivers, Minnow.

Sheepshead minnow (Cyprinodon variegatus) maintained at 10, 16, 23, 29 and 35 C, were exposed for varying periods of time (2-96 h) to 2-1 solutions of 60 ng 14C DEHP/ml. After exposure, the amount of DEHP in the fish, its concentration in the water and the amount of DEHP metabolites in both fish and water samples were determined. The fish were characterized by a two compartment clearance constant based pharmacokinetic model. The absorption clearance increased linearly with temperature probably due to a temperature-induced increase in gill blood flow. The amount of DEHP accumulated by the fish at 72 h was 6-fold larger at 35 C compared with 10 C. The metabolic clearance also increased as a function of temperature and appeared to have maximum value between 29 and 35 C. Temperature had a significant effect on the distribution kinetics of DEHP as reflected by the 13-fold increase in the intercompartmental clearance constant. The apparent volume of distribution was strongly temperature dependent, probably due to temperature-sensitive partitioning into storage tissues. The model predicted bioconcentration factor increased exponentially with temperature from 45 at 10 C to 6510 at 35 C. This finding is significant because it indicates that the control of temperature is important whenever the kinetic behavior of DEHP is under consideration. (Author's abstract)
W90-01243

**ACUTE TOXICITY, UPTAKE, DEPURATION AND TISSUE DISTRIBUTION OF TRI-N-BUTYLTIN IN RAINBOW TROUT, SALMO GAIRDNERI.**
Waterloo Univ. (Ontario). Dept. of Biology.
R. C. Martin, D. G. Dixon, R. J. Maguire, P. V. Hodson, and R. J. Tkacz.
Aquatic Toxicology AQTODG, Vol. 15, No. 1, p 37-52, July 1989. 4 fig, 2 tab, 38 ref. Department of Fisheries and Oceans Canada contract OSE83-00026.

Descriptors: *Fate of pollutants, *Path of pollutants, *Toxicity, *Antifoulants, *Pesticides, *Water pollution effects, *Organotin compounds, *Trout, *Fish, Depuration, Absorption.

The acute toxicity and accumulation of tri-butyltin cation (Bu3Sn(+)) in representative freshwater

fish is assessed. Bu3Sn(+), the active ingredient in organotin-containing antifouling paints, was highly toxic to rainbow trout (Salmo gairdneri, mean weight, 1.5 g); the 96-h LC50 was 1.41 microg Sn/l. Lake trout (Salvelinus namaycush, mean weight, 5.9 g) were more tolerant, with a 96-h LC50 of 5.21 microg Sn/l. Rainbow trout concentrated significant levels of Bu3Sn(+) during a 64-d exposure at 0.21 microg Sn/l, with bioconcentration factors of 406 and 570 (based on Bu3Sn(+) and total Sn, respectively). Rainbow trout depurated Sn slowly on transfer to Bu3Sn(+)-free water. During the 32 d period following transfer, the whole body concentration of Bu3Sn(+) fell by 25% while the total Sn concentration was reduced by 17%. The total Sn concentration in tissues of rainbow trout at the end of the 15-d exposure to 0.42 microg Sn/l indicated that Bu3Sn(+) partitions into trout on the basis of a three-compartment model. Peritoneal fat (mean concentration, 9.18 mg Sn/kg) constituted one compartment, kidney, liver and gall bladder/bile (mean concentration range, 3.07 to 3.72 mg Sn/kg) a second, and all other tissues (mean concentration range, 0.49 to 1.53 mg Sn/kg) a third. After 15 d of depuration, the system had simplified; only two compartments (liver plus gall bladder/bile and all other tissues) were apparent. Varying proportions of Bu3Sn(+) and its metabolites di-n-butyltin, n-butyltin and inorganic tine were present in all tissues sampled. The percent of metabolites in liver 974) and gall bladder (89) were, however, significantly higher than the levels in all other tissues, which ranged from 10 to 43. This suggests hepatic dealkylation and biliary-fecal excretion. (Author's abstract)
W90-01244

**LABORATORY STUDY OF THE EFFECTS OF WATERBORNE CADMIUM, CALCIUM, AND CARBONATE CONCENTRATIONS ON CADMIUM CONCENTRATIONS IN HYALLELA AZTECA (CRUSTACEA: AMPHIPODA).**
Guelph Univ. (Ontario). Dept. of Zoology.
For primary bibliographic entry see Field 5C.
W90-01245

**RELATIONSHIP BETWEEN RAIN AND SNOW ACIDITY AND AIR MASS TRAJECTORY IN EASTERN FRANCE.**
Paris-7 Univ. (France). Lab. de Physico-Chimie de l'Atmosphere.
J. L. Colin, D. Renard, V. Lescoat, J. L. Jaffrezo, and J. M. Gross.
Atmospheric Environment ATENBP, Vol. 23, No. 7, p 1487-1489, July 1989. 4 fig, 5 tab, 49 ref.

Descriptors: *Water pollution sources, *Acid rain, *Precipitation, *Snow, *Air pollution, France, Trajectories, Synoptic scale.

Twenty-nine rain and snow precipitations were collected event-by-event in March and April 1985 on a forest site in Vosges (Col du Domon, France) and analyzed for major inorganic components. The use of tridimensional air mas trajectories on the synoptic scale makes is possible to determine the origin of the air masses associated with precipitation. A classification of these events is made according to sectors with different industrialization. Subsets prove to be well-individualized for parameters related to acidity. Air masses coming from the north-east are associated with the most acidic precipitation and the highest SO4(-) and NO3(-) concentrations. The classification obtained is confirmed by calculation of enrichment factors relative to seawater and crustal models. The results, extended to marine and crustal species corroborate that medium and long-range transport of elements determine strongly the chemistry of precipitation at this type of site. These results have a direct and practical application. Snow appears to be more acidic than rain, since it is often associated with events from the north or east sectors during winter on this mountainous site. This type of precipitation must be taken into account more precisely in deposition flux evaluations. (Author's abstract)
W90-01249

**STUDY OF THE SOURCES OF ACID PRECIPITATION IN ONTARIO, CANADA.**
Illinois Univ., Urbana. Dept. of Civil Engineering.
Y. Zeng, and P. Hopke.
Atmospheric Environment ATENBP, Vol. 23, No. 7, p 1499-1509, July 1989. 13 fig, 4 tab, 10 ref. Ontario Ministry of the Environment project no. 311PL and NSF grant ATM 85-20533.

Descriptors: *Water pollution sources, *Acid rain, *Precipitation, *Canada, Factor analysis.

Since 1980, the Acid Precipitation in Ontario Study (APIOS) Event Wet/Dry Deposition Network has collected a substantial precipitation chemical data base. Data from the three stations in Dorset, Kingston and London were selected for investigation of the constituents found in the collected precipitation. Factor analysis was applied to the chemical data sets. Three factors reproduce the concentrations observed in precipitation. These factors represent the acid gas sources (SO2 and Nox sources), Ca and Mg sources and Na and Cl sources (marine aerosol). The acid gas sources are responsible for the acidity of the precipitation sample time periods are incorporated into the factor analysis with the chemical data. This information is in the form of the geographic distribution of back trajectory endpoints. The region in which trajectory endpoints fall is divided into subregions. New variables are defined as the number of the endpoints in each of the subregions. They reflect the residence time of the air parcels passed. Factor analysis is applied to the combined chemical and endpoint variable data sets. The results show the relationship between the chemical nature of the sources and the geographic regions that the air parcels passed. The potential source contribution function (PSCF) is another approach to locate the sources. PSCF is a conditional probability function. it can be calculated for each 1 degree longitude by 1 degree latitude cell by dividing the number of trajectory endpoints that correspond to samples with factor scores or pollutant concentrations greater that specified values by the number of total endpoints in the cell. Source areas are indicated by high PSCF values. Both of the approaches suggest that the Ohio River Valley and some areas along the east coast are major source areas for the observed precipitation acidity in Ontario. (Author's abstract)
W90-01250

**RELATIONSHIP BETWEEN SECONDARY SULFATE AND PRIMARY REGIONAL SIGNATURES IN NORTHEASTERN AERGSOL AND PRECIPITATION.**
Rhode Island Univ., Narragansett. Center for Atmospheric Chemistry Studies.
D. H. Lowenthal, and K. A. Rahn.
Atmospheric Environment ATENBP, Vol. 23, No. 7, p 1511-1515, July 1989. 5 fig, 1 tab, 11 ref. EPA grant R813451-01-0 and cooperative agreement CR-810905, DOE grant DE-FG22-84PC71253 and, Office of Naval Research contracts N00014-76-C-0435 and N000014-84-C-0035.

Descriptors: *Water pollution sources, *Sulfates, *Aerosols, *Precipitation, *Acid rain, Primary signatures, Rhode Island.

Regional apportionment of 3 years of aerosol and precipitation samples from Narragansett, RI, demonstrates that the relationship between secondary sulfate and primary signatures is functionally linear, at least for the main northeastern and midwestern source regions. Furthermore, the relationship for local (northeastern) sources appears to be no more variable than for the more-distant (midwestern) sources. The correlation of sulfate with regional signatures shows that the regionality of secondary sulfate is not significantly greater than that of the primary tracer elements. It should be noted that 'linearity' as used here differs from its common meaning in acid rain. Linearity, here, describes the empirical relationship between SO4(--) and primary regional tracers. It is descriptive, limited to simultaneous measurements of SO4(--) and the tracers, and does not explicitly involve SO2. The more conventional acid-rain linearity refers to the response of SO4(--) in air or precipitation to reductions in SO2 emissions. (Author's abstract)
W90-01251

**THEORY AND RESULTS FROM A QUASI-STEADY-STATE PRECIPITATION-SCAVENGING MODEL.**
Battelle Pacific Northwest Labs., Richland, WA.
C. M. Berkowitz, R. C. Easter, and B. C. Scott.
Atmospheric Environment ATENBP, Vol. 23, No. 7, p 1555-1571, July 1989. 10 fig, 4 tab, 26 ref. EPA interagency agreement EPA-DW89930059-01.

Descriptors: *Water pollution sources, *Acid rain, *Path of pollutants, *Precipitation, *Chemistry of precipitation, *Storms, Precipitation scavenging, Vertical velocity, Model studies.

A model that simulates a time-dependent, aqueous-phase chemistry/precipitation scavenging system within representative fields of steady-state cloud water, precipitation and vertical velocity is described. This model was designed for inclusion as a module in a regional-scale Eulerian air pollution model. Meteorological data from the regional-scale model are used to simulate a mass-consistent storm system where wet removal is described via mechanistic formulations, including mass transfer, accretion, and reactive scavenging. The meteorological fields are updated every hour, and are assumed to be uniform over discrete subregions of a larger horizontal region. The effects of aqueous-phase chemistry, scavenging, wet removal, and redistribution of pollutants by in-cloud transport are included in the governing equations. Observations given by Herrsegh and Hobbs were used to evaluate the performance of the stratiform component of the model. Average updraft speeds from the model agreed to within 0.01 g/cu m. Radar and tracer data presented by Dickerson et al. were used to evaluate the performance of the convective storm component of the model. Vertical velocities and precipitation amounts were also in good agreement. The scavenging model can also be run in a stand-alone mode, where the user defines a set of chemical and meteorological conditions. Using this mode, a comparison is presented between model predictions of aqueous chemistry concentrations and measurements taken during the OSCAR experiment. The results suggest that the model can replicate the magnitude and timing of concentration changes during such events. (Author's abstract)
W90-01252

**SIDE-EFFECTS OF PESTICIDES ON GROUND-DWELLING PREDATORY ARTHROPODS IN ARABLE ECOSYSTEMS.**
Agricultural Univ., Wageningen (Netherlands). Dept. of Toxicology.
For primary bibliographic entry see Field 5C.
W90-01256

**ACID RAIN OVER THE UNITED STATES AND CANADA: THE D.C. CIRCUIT FAILS TO PROVIDE SHELTER UNDER SECTION 115 OF THE CLEAN AIR ACT WHILE STATE ACTION PROVIDES A TEMPORARY UMBRELLA.**
For primary bibliographic entry see Field 5G.
W90-01264

**SYNOPSIS OF FRENCH EXPERIMENTAL AND IN SITU RESEARCH ON THE TERRESTRIAL AND MARINE BEHAVIOR OF TC.**
CEA Centre de La Hague, Cherbourg (France). Lab. de Radioecologie Marine.
M. Masson, F. Patti, C. Colle, P. Roucoux, and A. Grauby.
Health Physics HLTPAO, Vol. 57, No. 2, p 269-279, 1989. 5 fig, 3 tab, 24 ref.

Descriptors: *Path of pollutants, *Bioindicators, *Radioisotopes, *Metals, *Soil profiles, *Sediments, Distribution patterns, Marine plants, Marine bacteria, Marine environment, Algae, Technetium radioisotopes, English Channel, Water pollution sources, Bioaccumulation.

Terrestrial environment studies of the transfer of technetium have been essentially concerned with the evolution of soil deposition and soil-plant transfers. Experimentally determined coefficients of distribution in soils are low: 60-80% of technetium

remains hydrosoluble during the first months. Technetium emissions resulting from microbiological activity have been quantified. Antagonistic effects on Mo and Tc retention by soils are dependent on their respective concentrations. Four areas of soil-plant transfers have been studied: (1) root absorption kinetics relative to deposition of Tc, (2) interaction of stable Mo (environmental parameter) with the transfer of Tc to plants, (3) interaction of some long-lived radioisotopes (effluent parameters) with the transfer of Tc to plants, and (4) long-term soil-plant transfer and aging of deposited material. Of aquatic systems, only the marine environment has been studied. Under anoxic conditions in the presence of reducing sediments, the distribution coefficients were very high (1000). Concentration factors from water to organisms were generally very low (1 to 10); however, concentration factors greater than 1000 have been observed for some biota such as macrophytic brown algae, worms and lobsters. Biochemical analysis showed that Tc was essentially free and partially bonded to proteins. The transfer factors between sediments and species were very low (less than 0.5). The biological half-time was determined in some marine organisms that had accumulated Tc from water, food or sediments; the loss is biphasic. Uptake in edible parts was low. The physiochemical form affects the accumulation and loss of Tc. Analyses have quantified 99Tc in marine fauna and biota in the English Channel in relation to releases of the reprocessing plant of La Hague. Brown algae are the best bioindicators for following 99Tc dispersion in marine ecosystems. (See also W90-01270) (Author's abstract)
W90-01269

**ASSESSMENT OF DOSE TO MAN FROM RELEASES OF 99TC IN FRESH WATER SYSTEMS.**
Centre d'Etude de l'Energie Nucleaire, Mol (Belgium).
T. Zeevaert, C. M. Vandecasteele, and R. Kirchmann.
Health Physics HLTPAO, Vol. 57, No. 2, p 337-343, 1989. 1 fig, 6 tab, 12 ref, append.

Descriptors: *Path of pollutants, *Radioisotopes, *Metals, *Marine environment, *Irrigation, Technetium radioisotopes, Food chains, Population exposure.

The dose to man from releases of 99Tc in a fresh water system was evaluated and the biospheric transfer parameters to which the total dose is the most sensitive was identified. Only internal exposure was taken into account, as the external irradiation leads to a negligible dose contribution. Two release modes were considered: continuous (routine) releases and accidental releases. The concentration in the biospheric compartments subsequent to routine releases were calculated according to International Atomic Energy Agency procedures. For the accidental releases, a more dynamic approach was adopted, especially for the milk and meat compartments. A routine-release scenario typical for the Mol site has been applied, and the biospheric compartment leading to the highest dose contribution was shown to be the irrigated grain. The biospheric transfer parameters to which the first-year doses were the most sensitive, consisted mainly of the mass interception factor for grain and the milk transfer factor. The doses in following years depended on the value of the root zone removal rate. The accidental-release scenario resulted in committed dose equivalent values that are strongly influenced by the time of year at which the release occurs. (See also W90-01269) (Author's abstract)
W90-01270

**MUTAGENICITY ON CHLORINATION OF PRODUCTS FORMED BY OZONATION OF NAPHTHORESORCINOL IN WATER.**
Setsunan Univ., Neyagawa (Japan). Div. of Environmental Health.
For primary bibliographic entry see Field 2F.
W90-01274

**ACID RAIN REGULATION: FEDERAL FAILURE AND STATE SUCCESS.**
Hamline Univ., St. Paul, MN.
For primary bibliographic entry see Field 5G.
W90-01275

**IMPACT OF REPEATED INSECTICIDAL TREATMENTS ON DRIFT AND BENTHOS OF A HEADWATER STREAM.**
Georgia Univ., Athens. Dept. of Entomology.
For primary bibliographic entry see Field 5C.
W90-01278

**SPECIATION OF ALUMINUM, CADMIUM, COPPER, AND LEAD IN HUMIC SOIL SOLUTIONS: A COMPARISON OF THE ION EXCHANGE COLUMN PROCEDURE AND EQUILIBRIUM DIALYIS.**
Lund Univ. (Sweden). Dept. of Ecology.
D. Bergren.
International Journal of Environmental Analytical Chemistry IJEAA3, Vol. 35, No. 1, p 1-15, 1989. 7 fig, 4 tab, 35 ref.

Descriptors: *Water analysis, *Speciation, *Path of pollutants, *Aluminum, *Copper, *Lead, *Ion exchange, Dialysis, Equilibrium dialysis, Humic acids.

Metal speciation of Al, Cd, Cu, and Pb was studied in soil solutions containing humic substances (HS). The ion exchange column procedure was optimized and compared with a modification of the equilibrium dialysis (ED). A soil solution, for which the metal speciation at equilibrium could be calculated, was obtained from the ED. The solution was processed through columns with pH-adjusted (pH effluent = pH influent) and Na(+) saturated strong cation exchange resins. Using a pH-adjusted exchanger, there was only a slight dissociation of Al-humic complexes (AlHS) in the column (average of x = 7%). The dissociation was independent of pH (4.0-5.5) and v sub Al (micromol Al bound/g HS) in the range 51-500. The kinetic ability of CdHS, CuHS, and PbHS in the pH-adjusted exchanger (Cd > Pb > Cu) was greater for AlHS. Among the heavy metals, the ion exchange column procedure was most suitable for fractionating Cu into humic and non-humic forms. The CuHS concentration obtained with the Na(+) exchanger was 90-109% of the one obtained with ED, the variability being independent of v sub Cu (micromol Cu bound/g HS), though slightly dependent of sample pH. (Author's abstract)
W90-01279

**CADMIUM IN SEAWATER RECORDED BY MUSSELS: REGIONAL DECLINE ESTABLISHED.**
H. Fischer.
Marine Ecolgy Progress Series MESEDT, Vol. 55, No. 1, p 159-169, July 27, 1989. 4 fig, 5 tab, 42 ref.

Descriptors: *Bioindicators, *Water pollution sources, *Path of pollutants, *Mussels, *Cadmium, *Seawater, *Regional analysis, Fjords, Bioindicators.

The mussel Mytilus edulis is used as quantitative indicator of dissolved cadmium in the water of the Kieler Forder in comparison with a reference site in the Kieler Bucht (western Baltic Sea). As recorded by the mussel, the baseline Cd concentration in the Kieler Bucht decline from about 65 ng/l in 19890 to 35 ng/l in 1984. Recalculations of literature data suggest that 1975-1976 Kieler Bucht level was about 110 ng/l. The normal distribution of dissolved Cd in the Kieler Forde was characterized by about 140% of the baseline in the harbor area, 85% in the inner fjord, and 120 to 140% in the outer fjord. Other patterns indicated by the mussel are considered to reflect occasional coincidence of hydrographic stagnation and specific events (harbor dredging, sewage pollution, industrial discharges). After that 'mussel watch' records may be relied upon if the mussels had been affected by anoxic conditions. 'Mussel watch' estimates of chemical water quality documented a downward trend of dissolved Cd in the SW Kieler Bucht, which corresponds to the information available from analytical seawater chemistry. According to the regional hydrography, this is conceived to reflect a decline of dissolved Cd and possibly other metals on a broader geographical scale. (Author's abstract)
W90-01292

**PHOSPHORUS RELEASE FROM A HYPERTROPHIC LAKE SEDIMENT: EXPERIMENTS WITH INTACT SEDIMENT CORES IN A CONTINUOUS FLOW SYSTEM.**
National Environmental Research Inst., Silkeborg (Denmark).
For primary bibliographic entry see Field 5G.
W90-01301

**COMMUNITY-ACQUIRED LEGIONNAIRES' DISEASE ASSOCIATED WITH A COOLING TOWER: EVIDENCE FOR LONGER-DISTANCE TRANSPORT OF LEGIONELLA PNEUMOPHILA.**
Johns Hopkins Univ., Baltimore, MD. School of Hygiene and Public Health.
D. G. Addiss, J. P. Davis, M. LaVenture, P. J. Wand, and M. A. Hutchinson.
American Journal of Epidemiology AJEPAS, Vol. 130, No. 3, p 557-568, September 1989. 2 fig, 2 tab, 24 ref.

Descriptors: *Water pollution sources, *Path of pollutants, *Epidemiology, *Human diseases, *Infection, *Legionella, *Air conditioning, *Cooling towers, *Aerosols, Sheboygan, Wisconsin.

In the period August 10-29, 1986, 29 confirmed cases of Legionnaire's disease occurred in Sheboygan, Wisconsin; two cases were fatal. No common source of indoor exposure was identified. Water specimens were obtained from all known cooling water tower units in Sheboygan. Legionella pneumophila serogroup 1 was isolated at 1 million colony-forming units from a specimen obtained at plant A, a manufacturing facility north of the Sheboygan River. This isolate was identical to the only clinical isolate by monoclonal antibody and isoenzyme subgrouping. Of 29 persons with Legionnaire's disease, 21 lived or worked within one mile of plant A; 7 of the remaining 8 visited within 1-2 miles of plant A from 3-7 days before onset of illness. Attack rates were highest for persons living within 0.5 mile of plant A. These findings associate a cooling tower with community-acquired Legionnaire's disease and suggest that dissemination of Legionella may occur over longer than previously recognized distances. (Author's abstract)
W90-01305

**BAHIA LAS MINAS OIL SPILL: HYDROCARBON UPTAKE BY REEF BUILDING CORALS.**
Bermuda Biological Station for Research, Ferry Reach.
K. A. Burns, and A. H. Knap.
Marine Pollution Bulletin MPNBAZ, Vol. 20, No. 8, p 391-398, August 1989. 3 fig, 4 tab, 21 ref. U.S. Minerals Management Service contract no. 14-12-0001-30393.

Descriptors: *Oil spills, *Water pollution effects, *Corals, *Reefs, *Path of pollutants, *Hydrocarbons, *Fate of pollutants, Leaching, Proteins, Lipids, Panama.

This study reports the analyses of hydrocarbons in the tissues of reef building corals, reef sediments and seawater samples collected in September 1986 as part of the initial impact assessment of a major oil spill in Panama. The patterns of gas chromatograms indicated the oil residues were highly modified in comparison with the oil spilled only 5 months before: volatile fractions and predominant n-alkanes were missing. Oil levels in corals from the heavily oiled areas were 25-50 mg/g lipid as measured by UV fluorescence, while corals in control sites showed nearly non-detectable levels (0.1 mg/g). OIl concentrations correlated with coral mortality rates as measured by decrease in area coverage. Concentrations of petroleum hydrocarbons in reef sediments were also elevated in areas of high oiling (3.93 microgram/g dry wt) com-

pared to control areas (0.1 microgram/g). High concentrations of oil in seawater surrounding the contiguous mangroves (5-29 microgram/l) imply that leaching of oil from heavily oiled sediments will provide a source of contamination to the coral communities for an unknown time in the future. Modifications in the protein/lipid ratios of coral tissues were evident in these preliminary data, indicating that oiling affected the lipid biochemistry of the surviving corals. (Author's abstract)
W90-01332

**MEIOBENTHIC AND MACROBENTHIC COMMUNITY STRUCTURE ALONG A PUTATIVE POLLUTION GRADIENT IN SOUTHERN PORTUGAL.**
Marine Biological Association of the United Kingdom, Plymouth (England).
For primary bibliographic entry see Field 5C.
W90-01333

**CARCINOGENIC TRYPTOPHAN PYROLYSIS PRODUCTS IN AIRBORNE PARTICLES AND RAIN WATER.**
Tokyo Univ. (Japan). Dept. of Hygiene and Preventive Medicine.
S. Manabe, E. Uchino, and O. Wada.
Mutation Research MUREAV, Vol. 226, No. 4, p 215-221, August 1989. 3 fig, 2 tab, 14 ref. Ministry of Education, Science and Culture grants A-63440029 and B-63480174.

Descriptors: *Water pollution sources, *Carcinogens, *Rain, *Air pollution, Tryptophan pyrolysis products, Japan.

This is the first report that carcinogenic tryptophan pyrolysis products are present in airborne particles and rain water. The airborne particles were collected from August 1988 through October 1988 at 4 locations in Japan. The amounts of 3-amino-1,4-dimethyl-5H-pyrido(4,3-b)indole (Trp-P-1) and 3-amino-1-methyl-5H-pyrido(4,3-b)indole (Trp-P-2) in the air were 0.23 0.17 pg/cu m air (mean SD, n=18) and 0.16 0.15 pg/cu m air (n=18), respectively. These carcinogens were also detected in rain water. These results indicate that Trp-P-1 and Trp-P-2 are ubiquitous environmental components. (Author's abstract)
W90-01334

**POLLUTANT WASHOFF UNDER NOISE-CORRUPTED RUNOFF CONDITIONS.**
McMaster Univ., Hamilton (Ontario). Dept. of Civil Engineering and Engineering Mechanics.
G. G. Patry, and A. Kennedy.
Journal of Water Resources Planning and Management (ASCE) JWRMD5, Vol. 115, No. 5, p 646-657, September 1989. 9 fig, 10 ref.

Descriptors: *Water pollution sources, *Nonpoint pollution sources, *Path of pollutants, *Model studies, *Simulation analysis, *Rainfall-runoff relationships, *Surface runoff, *Probability distribution, Monte Carlo method, Noise, Pollution load.

Water quality and quantity models are routinely used in planning and design of water resources systems. Emphasis has most recently focused on the development of deterministic models. The first-order surface pollutant washoff model is examined under noise-corrupted runoff conditions. Statistics of the pollutant load are derived using the derived probability distribution concept and verified using Monte Carlo simulations. The investigation demonstrates that under noise-corrupted runoff conditions a bias is introduced in the estimate of the pollutant load. The bias is sensitive to: (1) the time step of the simulation; (2) the variance of the noise in runoff; and (3) the time from the start of the simulation (duration of the simulation). Statistics are derived for both the incremental pollutant washoff load and the mass of pollutant remaining on the street surface. The results of this study can be incorporated in any rainfall-runoff model that makes use of the first-order pollutant washoff model. (Author's abstract)
W90-01349

**STATISTICAL LONG-RANGE TRANSPORT MODEL FOR SIMULATION OF WET SULPHATE DEPOSITION.**
Waterloo Univ. (Ontario). Dept. of Chemical Engineering.
J. M. Byrne, E. A. McBean, K. B. Shipley, and G. J. Farquhar.
Canadian Journal of Civil Engineering CJCEB8, Vol. 16, No. 3, p 258-266, June 1989. 4 fig, 7 tab, 15 ref.

Descriptors: *Acid rain, *Model studies, *Sulfates, *Air pollution, North America, Transfer coefficients, Seasonal variation, Meteorology, Data requirements, Data processing.

A statistical long-range transport of air pollutants model (UW-LRT) has been developed and used to simulate wet SO4 deposition in eastern North America in 1980. The UW-LRT model computes transfer coefficients using a small number of scavenging and dispersion parameters to reflect seasonal or annual meteorology. In a comparison of the relative errors associated with four long-range transport models (LRT), the UW-LRT model demonstrated the lowest variation from recorded, analyzed deposition data. The UW-LRT model has modest data inputs and central processor unit time requirements. (Author's abstract)
W90-01363

**STUDY OF WATER QUALITY IN AN URBAN RIVER AND POTENTIAL IMPROVEMENT USING A PROTOTYPE INSTREAM AERATOR.**
Urban Systems Ltd., Kamloops (British Columbia).
C. A. Town, D. S. Mavinic, and B. Moore.
Canadian Journal of Civil Engineering CJCEB8, Vol. 16, No. 3, p 308-316, June 1989. 7 fig, 3 tab, 12 ref.

Descriptors: *Fishkill, *Oxygen depletion, *Instream aeration, *Water pollution treatment, *Eutrophication, Chlorophyll a, Oxygen demand, Monitoring, Serpentine River, British Columbia, Canada.

Urban encroachment and intensive agricultural activity within the Serpentine-Nicomekl watershed (near Vancouver, B.C.) have caused a series of fish (salmon) kills on the Serpentine River since 1980. Low dissolved oxygen was responsible for these kills. This field project investigated some of the dynamic chemical and biological relationships within the river, as well as the use of an instream aerator as a temporary, in situ, water quality improvement measure. Weekly sampling for a 6-month period during the latter half of 1985 established a solid data base for deriving and interpreting meaningful interrelationships. A strong correlation between chlorophyll a and dissolved oxygen levels before the algae die-off supported the hypothesis that algae blooms dying in the fall could create a serious oxygen demand. Because of these environmental conditions, the river is unable to sustain healthy dissolved oxygen levels during this period. A prototype, 460 m artificial aeration line was designed, installed, and monitored to evaluate its potential for alleviating low dissolved oxygen conditions and improving overall water quality during the critical fall period. The instream aerator ran continuously for over 2 months, starting in September 1985. Despite better-than-expected weather conditions and relatively high dissolved oxygen levels during the fall of 1985, the data base appeared to support the use of this prototype aeration unit as a means of 'upgrading' a stretch of an urban river subject to periodic, low dissolved oxygen levels. As a result, a 2-year follow-up study and river monitoring was initiated. In both 1986 and 1987, late summer and early fall river conditions resulted in the potential for serious salmon kills. In both instances, the instream aerator prevented such fish kills in a key stretch of the river. (Author's abstract)
W90-01366

**LEACHATE: PRODUCTION AND CHARACTERIZATION.**
Waterloo Univ. (Ontario). Dept. of Chemical Engineering.
G. J. Farquhar.
Canadian Journal of Civil Engineering CJCEB8, Vol. 16, No. 3, p 317-325, June 1989. 8 fig, 8 tab, 19 ref.

Descriptors: *Water pollution sources, *Model studies, *Leachates, *Landfills, *Waste dumps, *Groundwater pollution, Mathematical models, Computer models, Water balance method, HELP model, Flow rates, Variability, Data processing.

Current methods and data available for estimating leachate production and variability are examined. The water balance method (WBM) is a manual procedure solved generally with monthly averaged values. The hydrologic evaluation of landfill performance (HELP) model is perhaps the best of the available computer models, and its use has become compulsory for Superfund Site evaluation. The HELP model, in addition to performing a water balance, also calculates a flow rate through the refuse and therefore estimates the time of first leachate appearance, However, channelling due to heterogeneities within the refuse reduces the accuracy of these flow rate calculations and tends to overestimate leachate arrival times. As leachate production (PERC) moves through the refuse, contaminants are mobilized into the liquid phase through dissolution and suspension from the stationary refuse phase, thus producing a contaminated leachate. Tables have been created to present typical contaminant concentrations as a function of site age based on experience and extensive review of pertinent technical literature. While these tables improve the ability to predict leachate strength, they do not take into account the variations which exist from site to site, the most important of which are moisture loading and site geometry. Therefore, a novel approach is presented that uses data on site geometry and moisture loading as produced from some form of water balance such as the HELP model and combines it with contaminant leaching curves to produce leachate concentration. (White-Reimer-PTT)
W90-01367

**SURVIVAL AND ACTIVITY OF SALMONELLA TYPHIMURIUM AND ESCHERICHIA COLI IN TROPICAL FRESHWATER.**
Puerto Rico Univ., Rio Piedras. Microbial Ecology Lab.
L. Jimenez, I. Miniz, G. A. Toranzos, and T.C. Hazen.
Journal of Applied Bacteriology JABAA4, Vol. 67, No. 1, p 61-69, July 1989. 7 fig, 1 tab, 35 ref. Sea Grant R/LR-08-87-THAI, NIH Public Health Service grants RR-2657 and RR-8102, US DOE Contract DE-AC09-76SR00001.

Descriptors: *Salmonella, *Escherichia coli, *Bacterial analysis, *Tropical regions, Rain forests, *Bioindicators, Respiration, Reproduction, Nucleic acids, Activity, Survival, Fecal contamination.

The survival of Salmonella typhimurium LT2 and Escherichia coli was studied in situ in a tropical rain forest watershed using membrane diffusion chambers. Numbers were determined by acridine orange staining and a Coulter counter. Population activity was determined by microautoradiography, cell respiration, frequency of dividing cells, and by nucleic acid composition. Numbers of S. typhimurium and E. coli decreased less than 1 log unit after 105 h as measured by direct count methods. Activity as measured by respiration, acridine orange activity, frequency of dividing cells, and microautoradiography indicated that both bacteria remained moderately active during the entire study. After 24 h, E. coli was more active than S. typhimurium, as measured by nucleic acid composition, and frequency of dividing cells. Both E. coli and S. typhimurium survived and remained active in this tropical rain forest watershed for more than 5 d, suggesting that S. typhimurium may be of prolonged public health significance once it is introduced into tropical surface waters. As E. coli was active and survived for a long time in this natural environment, it would seem to be unsuitable as an indicator of recent fecal contamination in tropical waters. (Author's abstract)
W90-01377

**THEORETICAL STUDY OF CHEMICAL KINETIC CONTROL IN THE SCAVENGING OF POLLUTANT GASES BY CLOUD AND RAIN DROPS.**
California Univ., Los Angeles. Dept. of Atmospheric Sciences.
J. H. Topalian, and D. C. Montague.
Journal of Atmospheric Chemistry JATCE2, Vol. 8, No. 1, p 1-18, January 1988. 6 fig, 25 ref, append.

Descriptors: *Water pollution sources, *Acid rain, *Model studies, *Air pollution, *Atmospheric water, *Sulfates, Rain, Sulfur compounds, Convection, Diffusivity, Clouds, Chemical properties, Absorption.

Theoretical models that describe the uptake of trace gases by water drops falling at terminal velocity in air have been extended to include the effects of aqueous phase chemical processes that occur on time scales comparable with or greater than that over which the relevant physical scavenging processes operate. In particular, the case of reversible derivative formation by the absorbed species has been treated, and illustrated by application to the absorption of acetaldehyde under conditions prevailing in the atmosphere. Also, the relative influences of aqueous phase chemistry and of convective-diffusion on the efficiency of the scavenging process have been explored more generally, using the revised models. The scavenging characteristics of acetaldehyde, sulfur dioxide, and dichloromethane are compared. For sulfur dioxide, chemical equilibria are established within the drop at a rate that can be considered instantaneous compared to the diffusion rate, so that solution of the convective-diffusion equation is not only greatly simplified, but is as straightforward as for the case of dichloromethane. For acetaldehyde and other similar species, concurrent diffusion and chemical inter-conversion must be taken into account to model the scavenging process successfully: the approach to saturation of the drop takes place on a much longer time scale. This resistance to diffusion lies almost entirely in the gas phase when the trace gas partial pressure for dichloromethane and sulfur dioxide is low. It is concluded that examination of the scavenging characteristics of the three dissimilar gases, sulfur dioxide, dichloromethane, and acetaldehyde, shows that the differences in their washout behavior under similar environmental conditions are largely determined by the differences in their respective aqueous phase chemistries. (Friedmann-PTT)
W90-01386

**SULFUR DIOXIDE IN RAIN CLOUDS; GAS-LIQUID SCAVENGING EFFICIENCIES AND WET DEPOSITION RATES IN THE PRESENCE OF FORMALDEHYDE.**
Max-Planck-Inst. fuer Chemie, Mainz (Germany, F.R.).
P. Warneck.
Journal of Atmospheric Chemistry JATCE2, Vol. 8, No. 2, p 99-117, February 1988. 3 fig, 6 tab, 57 ref.

Descriptors: *Acid rain, *Air pollution, *Atmospheric water, *Sulfur compounds, *Sulfates, *Water pollution sources, Organic compounds, Equilibrium, Rain, Clouds.

The interaction of formaldehyde with SO2 dissolved in the aqueous phase of clouds leads to the formation of hydroxymethane sulfonate. The impact of this process upon the gas-liquid equilibrium distribution of SO2 in rain clouds and the ensuing wet SO2 precipitation rate is explored. Model vertical SO2 distributions are derived from observational data for three atmospheric regions: continental polluted, continental remote, and marine. The wet deposition rate for SO2 in the polluted atmosphere increases by about a factor of two in the presence of formaldehyde compared with its absence. The effect is much stronger in the remote atmosphere leading to a potentially significant enhancement of wet SO2 deposition. In the marine atmosphere, wet deposition of SO2 may contribute as much as 35% to the total removal rate for SO2 by all processes including dry deposition and chemical conversion to sulfate. (Author's abstract)
W90-01387

**ABSORPTION AND DESORPTION OF DICHLOROMETHANE VAPOR BY WATER DROPS IN AIR: AN EXPERIMENTAL TEST OF SCAVENGING THEORY.**
California Univ., Los Angeles. Dept. of Atmospheric Sciences.
S. Lopez, J. H. Topalian, S. K. Mitra, and D. C. Montague.
Journal of Atmospheric Chemistry JATCE2, Vol. 8, No. 2, p 175-188, February 1988. 5 fig, 27 ref.

Descriptors: *Water pollution sources, *Atmospheric water, *Path of pollutants, *Organic compounds, *Water vapor, *Air pollution, *Absorption, Rain, Clouds, Chemical properties, Precipitation, Diffusivity.

An experimental study of the scavenging of dichloromethane vapor by water drops falling at terminal velocity, has been carried out in the UCLA precipitation shaft, in order to test the predictions of theoretical washout models. Whereas good agreement between theory and experiment was found for drops of radius 0.332 mm, computed gas uptake rates for 1.253 and 2.21 mm radius drops were much slower than those measured, just as reported previously for the washout of both sulfur dioxide and acetaldehyde. An analysis shows that theory can be reconciled with all of the experimental data by replacing the compound specific aqueous phase Fickian molecular diffusion coefficient used in the theory, by an 'effective diffusivity,' having a constant value (0.0003 sq cm/s), independent of the physical and chemical nature of the absorbed species, for all drops of equivalent radii greater than 0.9 mm. (Author's abstract)
W90-01388

**PARTICULATE SULFATE LEVELS AT A RURAL SITE IN ISRAEL.**
Hebrew Univ., Jerusalem (Israel). School of Applied Science and Technology.
M. Luria, Lifschitz, and M. Peleg.
Journal of Atmospheric Chemistry JATCE2, Vol. 8, No. 3, p 241-250, March 1988. 4 fig, 1 tab, 17 ref.

Descriptors: *Acid rain, *Water pollution sources, *Pollutant identification, *Particulate matter, *Sulfates, *Israel, *Rural areas, Nitrates, Ozone, Meteorological data collection, Air pollution.

Ambient particulate sulfate measurements have been intermittently performed at a rural site in Israel over a period of more than two years. Concurrent measurement of ambient pollutants (SO2, NO-NOx, and O3), as well as meteorological data, were also carried out. The daily data included four particulate sulfate samples representing four successive 6 h accumulating periods. The measured concentrations of sulfate ions ranged from a low 2 micrograms/cu m observed during the winter season to a high of > 50 micrograms/cu m obtained during the summer. Little correlation was obtained between the sulfate concentration and either O3 or SO2, although sulfate and O3 showed a similar diurnal and annual trend. Based on the data distribution and on a photochemical model, it was concluded that a large part of the particulate sulfate observed at the eastern coast of the Mediterranean Sea must be related to long-range transport from distant sources. (Author's abstract)
W90-01389

**FLUXES OF UNDISSOCIATED ACIDS TO TERRESTRIAL ECOSYSTEMS BY ATMOSPHERIC DEPOSITION.**
Oak Ridge National Lab., TN. Environmental Sciences Div.
D. A. Schaefer, S. E. Lindberg, and W. A. Hoffman.
Tellus TELLAL, Vol. 41B, No. 3, p 207-218, July 1989. 1 fig, 4 tab, 42 ref. append.

Descriptors: *Water pollution sources, *Acid rain, *Air pollution, *Ecosystems, *Atmospheric water, *Throughfall, Canopy, Coniferous forests, Clouds, Fog.

Undissociated acids in the troposphere are transferred to terrestrial ecosystems as wet deposition in rain and cloud/fog water and as particulate and gaseous dry deposition during interstorm intervals. Wet deposition can be measured directly, and the sum of dry deposition and canopy release of undissociated acids can be estimated from net canopy wash-off into throughfall (TF). Samples of rain, cloud and fog water, and TF were collected from April 1986 through March 1987 at low-elevation (230 m) and high-elevation (1730 m) coniferous forests in Tennessee. The samples were titrated for total acidity by Gran's method, and undissociated acidity was calculated as total acid (Gran) minus free acidity (pH measurement). During that 12-month period, the undissociated acid fluxes in wet deposition at these sites were both 34 mmol/sq m, comparable to the free acid fluxes in wet deposition. Fog water fluxes at the lower site were negligible, but at the high-elevation site cloud water was potentially responsible for considerable deposition of undissociated acids to the forest canopy. Dry deposition plus canopy fluxes of undissociated acids were greater at the higher site. Dry deposition plus canopy fluxes averaged 54 mmol/sq m-yr (range 36-77) at the low-elevation site and 82 mmol/sq m-yr (range 77-86) at the high-elevation site. Undissociated acidity in TF consists of biological metabolites and cuticular decomposition products and dry-deposited compounds washed from plant surfaces. Formic and acetic acid concentrations in TF do not exceed those found in rain, therefore dry depositions of those acids cannot account for the undissociated acidity of TF. The relative importance of wet and dry deposition of undissociated acid to terrestrial ecosystems would be further clarified by identifying the weak acids in TF. (Author's abstract)
W90-01397

**CARBOXYLIC ACIDS AND CARBONYL COMPOUNDS IN SOUTHERN CALIFORNIA CLOUDS AND FOGS.**
California Inst. of Tech., Pasadena. W.M. Keck Lab. of Environmental Engineering Science.
J. W. Munger, J. Collett, B. C. Daube, and M. R. Hoffmann.
Tellus TELLAL, Vol. 41B, No. 3, p 230-242, July 1989. 11 fig, 4 tab, 38 ref.

Descriptors: *Acid rain, *Carboxylic acid, *Carbonyl compounds, *Water pollution sources, *Pollutant identification, *Clouds, *Fog, *Air pollution, *California, Organic compounds, Hydrogen ion concentration, Atmospheric water.

Formaldehyde, formate, and acetate have been determined in fog and cloudwater from several areas of southern California. Up to 190 micromoles formate and acetate was seen in high pH fog samples from the San Joaquin Valley. Formaldehyde concentrations as high as 500 micromoles were observed there. Organic acid concentrations were much lower at an acidic site along the margin of the valley. Fog from Riverside, CA had maximum concentrations of 1500 and 500 micromoles formate and acetate. The highest concentrations were observed in the samples with highest pH. Formaldehyde at Riverside was as high as 380 micromoles. Average formate and acetate concentrations in intercepted stratus clouds from the Santa Barabara Channel coast and San Pedro Hill were 20-60 micromoles and 10-30 micromoles, respectively. Formaldehyde concentrations in stratus clouds were 10-20 micromoles. Because the lifetime of a cloud or fog droplet is usually much longer than the characteristic time for interfacial mass transport, hydration or dissociation, droplets can be assumed to be in equilibrium with their surroundings. The product of aqueous-phase concentration and liquid water content in the cloud (fog) is nearly always much less than the predicted equilibrium partial pressure. only the high pH fogs from the San Joaquin Valley have the potential to deplete the gas-phase of organic acid. (Author's abstract)
W90-01398

**AIRBORNE ORGANOCHLORIDES IN THE CANADIAN HIGH ARCTIC.**

South Carolina Univ., Columbia. Dept. of Chemistry.
G. W. Patton, D. A. Hinckley, M. D. Walla, and T. F. Bidleman.
Tellus TELLAL, Vol. 41B, No. 3, p 243-255, July 1989. 4 fig, 6 tab, 33 ref, append. NATO Grant NATO 04-0667-86.

Descriptors: *Air pollution, *Pollutant identification, *Canada, Sampling, Gas chromatography, Mass spectrometry, Organic compounds, Atmosphere, Polychlorinated biphenyls, Chlorinated hydrocarbons.

In 1984, the Canadian Polar Continental Shelf Project established a research camp on a floating ice island in the Beaufort Sea. The 7x4 km island is presently located about 50 km off Ellesmere Island at about 81 degrees N, 100 degrees W. Air samples of 1400-3000 cu m were collected on the island in August-September 1986 and June 1987, using a filter-solid adsorbent train. Organochlorines in melted snow and Arctic Ocean surface water were preconcentrated using solid adsorbent cartridges. Samples were analyzed by capillary gas chromatography with electron capture detection, and by capillary gas chromatography-mass spectrometry in the negative ion and electron impact modes. Compounds quantified included hexachlorocyclohexanes, hexachlorobenzene, polychlorinated camphenes, chlordane, polychlorinated biphenyls, and DDT compounds (given in order of relative abundance, highest to lowest). Air-sea partitioning of HCH isomers relative to their equilibrium distribution are calculated from Henry's Law constants. This study has provided the first quantitative information on polychylorinated camphenes in Arctic air. (Author's abstract)
W90-01399

**ATMOSPHERIC DECAY DISTANCES AND TIMES FOR SULFUR AND NITROGEN OXIDES ESTIMATED FROM AIR AND PRECIPITATION MONITORING IN EASTERN CANADA.**
Atmospheric Environment Service, Downsview (Ontario).
P. W. Summers, and W. Fricke.
Tellus TELLAL, Vol. 41B, No. 3, p 286-295, July 1989. 7 fig, 4 tab, 19 ref.

Descriptors: *Air pollution, *Acid rain, *Water pollution sources, *Precipitation, *Sulfates, *Nitrates, *Canada, Sampling, Monitoring, Rainfall.

Previous estimates of residence times for sulfur species have been made mainly from the overall box budget approach by considering the various deposition and conversion terms in a 'static' reservoir. A 'dynamic' approach was used by considering daily filter-pack and precipitation observations taken at several eastern Canadian monitoring sites over a period of several years. Some of these sites are lined up from southwest to northeast along the most frequent wind direction for pollutant transport episodes. Concentrations can thus be examined in the Lagrangian sense starting at the edge of the major North American emission region and ending at a remote site in Newfoundland over 2000 km away. Plots of concentration of the monitored species in air and precipitation against distance from the emissions region, show a good fit to an exponential curve. The decay distances, defined as the distances for the initial concentration to fall to 1/e of its original value, can thus be determined. These are, in air: 480 km for SO2, 1280 km for SO4(2-), 720 km for total sulfur (SO2 + SO4(2-)), and 540 km for total nitrate (HNO3 + particulate nitrate). In precipitation, the decay distances are 1700 km for SO4(2-) and 1100 km for NO3(-). Using mean velocities for southwesterly trajectories across the region, the decay distances can be converted to decay times. These are estimated for air concentrations to be: 14 h for SO2; 58 h for SO4(2-); 24 h for total sulfur and 16 h for total nitrate. In the case of SO2, and total sulfur, the decay times are equivalent to residence times. (Author's abstract)
W90-01400

**BELOW-CLOUD SCAVENGING OF TROPOSPHERIC AMMONIA.**
Pennsylvania State Univ., University Park. Dept. of Meteorology.
J. P. Shimshock, and R. G. De Pena.
Tellus TELLAL, Vol. 41B, No. 3, p 296-304, July 1989. 1 fig, 3 tab, 23 ref. DOE Contracts FG02-85ER60294, 50-EANR-6-00011.

Descriptors: *Water pollution sources, *Ammonia, *Air pollution, Atmospheric water, Clouds, Mathematical studies, Precipitation, Rainfall, Atmosphere.

Below-cloud scavenging of tropospheric ammonia gas by raindrops was investigated by observing the change in the NH3(g) concentration measured before and during long precipitation events. The removal was parameterized as a first-order process; the scavenging coefficient, defined here as the first-order rate coefficient, was computed by two different methods: (1) the average 'measured' scavenging coefficient was calculated by taking into account the average 'pre-event' and 'event' concentrations and the duration of the event; (2) the average 'theoretical' scavenging coefficient was calculated by considering the diffusion of the gas to the raindrop, the intensity of precipitation during each hour of the event, and the raindrop size distribution. The scavenging coefficient was computed for fourteen precipitation events. The median 'measured' scavenging coefficient was 0.00013/s, which is equivalent to an e-folding time of 2.1 h. These values, however, spanned two orders of magnitude. A comparison of the 'measured' to 'theoretical' scavenging coefficients showed that these two quantities were within an order of magnitude of each other for most cases. The precipitation-scavenged ammonia was calculated as the difference between the gas concentrations at the beginning and end of the vent. For a majority of the events, the scavenged ammonia contributed less than 10% of the total ammonium found in precipitation. (Author's abstract)
W90-01401

**MICROBIAL INCORPORATION OF SULFATE INTO ORGANIC MATTER IN FOREST SOILS.**
Southeastern Forest Experiment Station, Otto, NC.
W. T. Swank, J. W. Fitzgerald, and T. C. Strickland.
IN: Forest Hydrology and Watershed Management. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication No. 167, 1987. p 3-10, 3 fig, 3 tab, 17 ref. NSF Grant No. BSR-8215259.

Descriptors: *Path of pollutants, *Forest hydrology, *Acid rain effects, *Sulfates, *Microbial degradation, *Fate of pollutants, Appalachian Mountains.

The metabolism of inorganic sulfate into organic matter by microbial populations can be an important process in the sulfur cycle of forest ecosystems. Potential annual incorporation in forest floor and soil horizons of a mixed deciduous forest in the Southern Appalachian Mountains was estimated to be 30 kg/ha. The process is partially responsible for the apparent sulfur accumulation indicated by ecosystem budgets and affects sulfate mobility, carbon leaching, and hence the interpretation of atmospheric sulfuric acid effects on forest ecosystems. (See also W90-01432) (Author's abstract)
W90-01433

**ACIDITY AND ALKALINITY OF RESERVOIR WATER IN THE SIERRA NEVADA, CALIFORNIA.**
California Univ., Berkeley. Dept. of Plant and Soil Biology.
J. G. McColl.
IN: Forest Hydrology and Watershed Management. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication No. 167, 1987. p 11-18, 2 fig, 4 tab, 4 ref.

Descriptors: *Water pollution sources, *Acid rain effects, *Hydrogen ion concentration, *Reservoirs, *Sulfates, *Nitrates, *Sierra Nevada, *California, Snowmelt, Seasonal variation, Path of pollutants.

During the 30-40 years prior to 1985, alkalinity decreased and acidity increased in outlet water from the reservoir supplying the metropolitan area east of San Francisco Bay. For acidity these changes occurred in all months of the year, but only in July through November for alkalinity. It is likely that greatest acidity increase in runoff is due to increased acidity of peak snowmelt in May. The cause appears to be atmospheric emissions of SO2 and NOx from the metropolitan area deposited in the Sierra Nevada drainage basin. Since the early 1970's, emissions varied greatly with fluctuating fuel oil prices and new control regulations, thus complicating relationships between gaseous emissions and reservoir water chemistry. However, with a 3 to 4-year lag time, significant correlations exist between gaseous emissions (especially SO2) and water acidity and alkalinity for two separate periods, 1955-72 and 1972-85. (See also W90-01432) (Author's abstract)
W90-01434

**DYNAMICS AND MASS BALANCES OF NO3(-) AND SO4(-2) IN MELTWATER AND SURFACE-RUNOFF DURING SPRING MELT IN A BOREAL FOREST.**
Quebec Univ., Sainte-Foy.
H. G. Jones, and Y. Bedard.
IN: Forest Hydrology and Watershed Management. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication No. 167, 1987. p 19-31, 4 fig, 2 tab, 21 ref.

Descriptors: *Acid rain, *Water pollution sources, *Canada, *Water pollution sources, *Snowmelt, *Soil chemistry, *Sulfates, *Nitrates, *Path of pollutants, *Runoff, Lake Laflamme.

The chemical evolution of meltwater from the snowpack, intermittent streamwaters and subsurface waters of the Lake Laflamme basin, Quebec, were studied during the spring melt periods of 1984 and 1985. It was found that the upper organic soil horizons (A0, A1) are the dominant factor in the control of NO3(-) concentrations in surface waters in 1984, these horizons acted as source for NO3(-) (2 meq/sq m) exceeding the NO3(-) load (10.0 meq/sq m) discharged by the snow pack (including precipitation). In 1985, the horizons acted as a sink for this ion by retaining 1.3 meq/sq m of the total load discharged (12.9 meq/sq m). In comparison, SO4(2-) concentrations in the runoff are more dependent on the chemical characteristics of water in the lower soil horizons (B1, B2). The upper horizons, however, exert a buffering effect on the concentration of this ion in the streamwaters. The soil horizons act generally as a source for SO4(-2) exceeding the SO4(-2) load discharged by the pack, supplying approx 40% (1984, 42%; 1985, 37%) of the total load of SO4(2-) (1984, 43.5 meq/sq m; 1985, 34.1 meq/sq m) exported by the surface runoff in both spring melt periods. (See also W90-01432) (Author's abstract)
W90-01435

**INFLUENCE OF ACID PRECIPITATION ON STREAM CHEMISTRY IN A SMALL FORESTED BASIN IN SOUTHWESTERN BRITISH COLUMBIA.**
British Columbia Univ., Vancouver. Faculty of Forestry.
M. C. Feller.
IN: Forest Hydrology and Watershed Management. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication No. 167, 1987. p 33-47, 2 fig, 7 tab, 19 ref. Dept. of Supply and Services Canada Contracts No. 06SB.KH603-4-1054 and No. 06SB.01K51-5-1084.

Descriptors: *Water pollution sources, *Canada, *Acid rain effects, *Forest hydrology, *Streams, *Sulfates, *Nitrates, Hydrogen ion concentration.

Precipitation and streamwater chemistry have been assessed since 1970 in a small forested drainage basin located in southwestern British Columbia. Precipitation in the area is acidic with mean annual pH values of 4.5-4.9 and anion chemistry dominat-

ed by SO4, followed by NO3. Streamwater in the area generally contains low quantities of dissolved chemicals and has a relatively low buffer capacity of 20-70 micromol/L. However, the acid precipitation has not significantly impacted streamwater chemistry. Streamwater pH values < 6.1 have not been recorded and pH decreases of only 0.1 to 0.4 occur during storm events. High streamwater dissolved Al(3+) concentrations do not occur and most of the dissolved Al is organically complexed. The soils present are being acidified causing basic cations to be released from the soil. Generation of hydrogen ions within the watersheds exceeds the external supply. (See also W90-01432) (Author's abstract)
W90-01436

**ACID BUFFERING IN LOWLAND FORESTED ECOSYSTEMS: A CASE STUDY IN THE TRENT BASIN, UK.**
Coventry (Lanchester) Polytechnic (England). Dept. of Geography.
I. D. L. Foster.
IN: Forest Hydrology and Watershed Management. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication No. 167, 1987. p 49-63, 5 fig, 3 tab, 31 ref.

Descriptors: *Water pollution sources, *Acid rain effects, *Forest hydrology, *Hydrogen ion concentration, *England.

Studies of the impact of acid precipitation on natural waters frequently concentrate on upland hard rock environments which usually illustrate a dramatic response in terms of water quality and ecological deterioration. Less well documented, especially in the UK, are river basins which receive acid inputs but where river waters remain at or above a neutral pH. A monitoring program was undertaken in the English Midlands. It is an area which has recorded mean monthly rainfall pH below 5.0 for 7 months of the yr, dropping to pH 4.5 in February. Canopy drip in a broad leaved oak woodland has an average annual pH of 4.1. Soil water samples extracted from the unsaturated zone closely mirror throughfall pH and show little buffering of acid inputs. Low pH values are not recorded in river and lake water samples collected in the same area, where pH lies between 7 and 7.5. (See also W90-01432) (Author's abstract)
W90-01437

**STREAM ACIDIFICATION RESULTING FROM AFFORESTATION IN THE UK: EVALUATION OF CAUSES AND POSSIBLE AMELIORATIVE MEASURES.**
Institute of Terrestrial Ecology, Bangor (Wales). Bangor Research Station.
M. Hornung, B. Reynolds, P. Stevens, and C. Neal.
IN: Forest Hydrology and Watershed Management. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication No. 167, 1987. p 65-74, 4 tab, 21 ref.

Descriptors: *Forest management, *Water pollution sources, *Acidification, *Reforestation, *Streams, *Forest hydrology, *Hydrogen ion concentration. United Kingdom, Population dynamics, Aluminum, Acidic water, Water pollution effects.

Recent studies have shown an increase in acidity and aluminum concentrations in streams draining plantation forests, compared with streams draining adjacent moorland or grassland, in some areas of the British uplands. These changes in streamwater chemistry have been linked to a parallel impoverishment of the freshwater invertebrate fauna, fish stocks and the populations of certain birds. Afforestation leads to a number of changes in the upland environment which, in turn, impact on the hydrology and hydrochemistry of drainage waters. Some of these changes are due to forest management practices while others result from crop-atmosphere and crop-soil interactions. The possible role of these changes, in the upland environment, in producing the increased streamwater acidity aluminum concentrations is considered. A range of proposed ameliorative measures, linked to management of drainage waters, is then assessed. (See also W90-01432) (Author's abstract)
W90-01438

**APPLICATION OF TIME-SERIES MODELLING TO SHORT-TERM STREAMWATER ACIDIFICATION IN UPLAND SCOTLAND.**
Imperial Coll. of Science and Technology, London (England). Dept. of Civil Engineering.
S. J. Langan, and P. G. Whitehead.
IN: Forest Hydrology and Watershed Management. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication No. 167, 1987. p 75-87, 7 fig, 3 tab, 10 ref.

Descriptors: *Water pollution sources, *Forest management, *Model studies, *Water quality, *Acid streams, *Scotland, Lime, Water pollution treatment.

Hourly discharge and stream pH have been modeled on 3 basins differentiated by land-use. The best-fit model for each of the basins has the same simple structure (first order autoregressive moving average type) identified from a calibration run on one moth of hourly observations. The results show that a moorland basin and a forested (8 year old Sitka Spruce) basin have broadly similar water quality. Results from the third part-forested, basin illustrate how retrogressive management techniques (e.g. liming) may ameliorate surface water acidification, both in terms of magnitude and duration. While the model is not particularly powerful in terms of predictability, it has been useful in identifying the differences between the 3 basins in terms of water quality. The modifying influence of land management techniques on one of the basins is particularly pertinent to the short-term solution of streamwater acidification. (See also W90-01432) (Author's abstract)
W90-01439

**CONTRIBUTIONS OF ACID DEPOSITION TO STREAMWATER CHEMISTRY IN THREE PRECAMBRIAN SHIELD BASINS.**
Great Lakes Forestry Research Centre, Sault Sainte Marie (Ontario).
J. A. Nicholson.
IN: Forest Hydrology and Watershed Management. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication No. 167, 1987. p 89-98, 1 fig, 4 tab, 13 ref.

Descriptors: *Water pollution sources, *Canada, *Acid streams, *Acid rain effects, *Sulfates, *Nitrates, *Bicarbonates, *Path of pollutants, Calcium, Ammonia.

Water and chemical budgets were examined for small, undisturbed mature forest basins in three areas across northern Ontario. Precipitation averages, based on 4 yrs, varied < 4% of normal, but variation of streamflow averages, though consistent at all sites, was 25-30% above normal. Sulfate input dominated precipitation at the eastern site and was 2x the SO4 input at the central site and 3x at the western site. Nitrate was highest in the east, being about 4x > at the other two sites. The H input was 5-6x greater at the eastern site. Output was dominated by SO4, Ca and HCO3, in the west, HCO3, Ca and SO4 at the central site, and SO4, HCO3 and Ca at the eastern site. Only two cations, H and NH4, were retained within the basin at all sites; both were highest in the east. All sites lost major cations; the largest loss was at the central site, which had the richest soil. Carbonate in glacial till was important in neutralizing acidity at the central and eastern sites. Results were compared with those of other basin budget studies on the Precambrian Shield. (See also W90-01432) (Author's abstract)
W90-01440

**SOURCES OF ACIDITY DURING SNOWMELT AT A FORESTED SITE IN THE WEST-CENTRAL ADIRONDACK MOUNTAINS, NEW YORK.**
Geological Survey, Doraville, GA.
N. E. Peters, and C. T. Driscoll.
IN: Forest Hydrology and Watershed Management. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication No. 167, 1987. p 99-108, 3 fig, 18 ref.

Descriptors: *Water pollution sources, *Snowmelt, *Acid streams, *Adirondack Mountains, *Acid rain effects, *Forest hydrology, *Path of pollutants, Sulfates, Nitrates.

The chemical quality of precipitation, snowpack, meltwater, and forest floor leachate was evaluated to determine the impact of these sources on stream acidification. Solutes in the snowpack were preferentially released at the beginning of snowmelt causing elevated concentrations of acidity and strong acid anions, NO3(-) and SO4(-2), in the meltwater; these decreased rapidly within a few days as the melt continued. Stream SO4(-2) concentration was relatively constant (140 meq/L) through winter. Groundwater discharge appears to be a primary control of the stream composition, because the stream SO4(-2) concentration was comparable to, or slightly lower than that of groundwater or soil water, but was more than double that of meltwater or forest floor leachate. Nitrification in the forest floor produced 2-3 times higher acidity (H+) and NO3(-) concentrations in leachates than in meltwater. Stream H+ and NO3(-) concentrations increased during late winter, and the increases are attributed to the flushing of these solutes from the forest floor through the soil to the stream. (See also W90-01432) (Author's abstract)
W90-01441

**FOREST INFLUENCE ON THE SURFACE WATER CHEMISTRY OF GRANITIC BASINS RECEIVING ACID PRECIPITATION IN THE VOSGES MASSIF, FRANCE.**
Strasbourg-1 Univ. (France). Inst. de Geologie.
A. Probst, B. Fritz, B. Ambroise, and D. Viville.
IN: Forest Hydrology and Watershed Management. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication No. 167, 1987. p 109-120, 3 fig, 3 tab, 16 ref.

Descriptors: *Water pollution sources, *France, *Acid rain effects, *Path of pollutants, *Forest hydrology, *Soil types, Hydrogen ion concentration, Neutralization, Sulfates, Nitrates.

The influence of acid rain on the chemistry of surface waters in two small basins is shown. The basins present similar altitudes and climates, only one is forested, and the forest decline has been clearly established. In both basins, rain water is polluted by acids (H(+), SO4(-2), NO3(-)). This acid input is neutralized in soils but the efficiency of that neutralization varies from one basin to another: (a) in the non-forested basin, the alkalinity of surface water dominates the anionic charge, (b) in the forested basin, the strong acid anions still dominate the anionic charge of a just neutralized solution. The chemistry of surface water in the forested basin cannot be explained only by the incident rainfall and its partial evaporation. There appears to be a major input of pollutant through dry deposits in throughfall. (See also W90-014323) (Author's abstract)
W90-01442

**RUNOFF AND EROSION IN CLEARINGS FOLLOWING CUTTING OF THE HUMID TROPICAL FOREST (ECOULEMENTS ET EROSION SOUS PRAIRIES ARTIFICIELLES APRES DEFRICHEMENT DE LA FORET TROPICALE HUMIDE).**
Office de la Recherche Scientifique et Technique Outre-Mer, Cayenne (French Guiana).
For primary bibliographic entry see Field 4C.
W90-01443

**EFFECT OF CLEARCUTTING ON CHEMICAL EXPORTS IN LATERAL FLOW FROM DIF-**

**FERING SOIL DEPTHS ON A SUBALPINE FORESTED SLOPE.**
Forest Service, Fort Collins, CO.
For primary bibliographic entry see Field 4C.
W90-01471

**DETERMINATION OF HYDROLOGICAL FLOW PATHS AND ASSOCIATED HYDROCHEMISTRY IN FORESTED CATCHMENTS IN CENTRAL SCOTLAND.**
Imperial Coll. of Science and Technology, London (England).
H. S. Wheater, S. J. Langan, J. S. Miller, and R. C. Ferrier.
IN: Forest Hydrology and Watershed Management. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication No. 167, 1987. p 433-449, 7 fig, 6 tab, 23 ref.

Descriptors: *Rainfall-runoff relationships, *Water chemistry, *Water pollution sources, *Forest watersheds, *Path of pollutants, *Acid rain, *Runoff, Flow pattern, Precipitation, Soil water, Monitoring, Water chemistry, Throughflow, Throughfall, Stemflow.

Replicated experimental plots were established as part of an acid deposition research project to determine hydrological flow paths and the associated hydrochemistry. Two adjacent forested catchments were used in areas of similar geology but with differing tree species, soil types and capacity to sustain a fish population. Cut soil faces were used to sample soil water throughflow from the major soil horizons. Baseline monitoring of accumulated precipitation, tree throughfall and stemflow, and soil water throughflow was carried out at fortnightly intervals on these plots, some of which were instrumented to include continuous recording of precipitation and soil water throughflow, event sampling and continuous monitoring of soil moisture dynamics using a distributed tensiometer network. The bulk chemical analyses presented indicate clearly the importance of canopy effects and the similarity in response of the dominant B/C horizon throughflow and stream chemistry. The three-dimensional monitoring of soil moisture state gives important insights into the partial response of the plot, and particularly the build up of flow in the B/C horizon. (See also W90-01432) (Author's abstract)
W90-01472

**IMPACT OF CONIFER AFFORESTATION ON WATER QUALITY IN AN UPLAND CATCHMENT IN SOUTHWEST ENGLAND.**
Plymouth Polytechnic (England). Dept. of Geographical Sciences.
A. G. Williams, J. L. Ternan, and M. Kent.
IN: Forest Hydrology and Watershed Management. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication No. 167, 1987. p 451-461, 3 fig, 1 tab, 20 ref.

Descriptors: *Acid rain, *Acidification, *Water chemistry, *Water pollution sources, *Forest watersheds, Surface runoff, *Soil water, Surface flow, Throughfall, Stemflow, Litterflow, Spruce trees, Solute concentrations.

Solute concentrations in throughfall, stemflow, litterflow, soil water and springs were monitored in a sitka spruce (Picea sitchensis) forest and in a non-forested area. Analyses of stream water upstream and downstream of the afforested area revealed increased solute concentrations resulting from enhanced entrapment of atmospheric salts by the trees and increased weathering arising from the production of organic acids and chelates from decaying spruce needles. No significant difference in acidification upstream and downstream of the forest was observed. It was concluded that release of nutrients from litter decomposition balances nutrient uptake and the release of base cations by weathering buffers the system. (See also W90-01432) (Author's abstract)
W90-01473

**DISSOLVED ORGANIC CARBON IN FORESTED AND CUTOVER DRAINAGE BASINS, WESTLAND, NEW ZEALAND.**
McGill Univ., Montreal (Quebec). Dept. of Geography.
For primary bibliographic entry see Field 4C.
W90-01476

**CARNATION CREEK, CANADA--REVIEW OF A WEST COAST FISH/FORESTRY WATERSHED IMPACT PROJECT.**
Pacific Forestry Centre, Victoria (British Columbia).
E. D. Hetherington.
IN: Forest Hydrology and Watershed Management. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication No. 167, 1987. p 531-538, 1 fig, 11 ref.

Descriptors: *Environmental impact, *Forest hydrology, *Water quality, *Rainfall-runoff relationships, *Forest watersheds, *Logging, *British Columbia, Salmon, Fisheries, Forest management, Water quality, Groundwater, Interagency cooperation.

Carnation Creek is a small, rainforest salmon stream located on the west coast of Vancouver Island, British Columbia. In 1970, a 16-yr multiagency and multi-disciplinary project was initiated to evaluate the effects of logging and silvicultural activities on the Carnation Creek watershed and communicate the results to managers of forests and fish. The nature and results of the project are reviewed, including a discussion of the transfer of research findings, their application by resource managers, and the significance of the project for fishery and forestry management in coastal British Columbia. Peak flows and water yield increased in a small tributary, groundwater levels were higher and there were minor changes in water quality. There were also major changes in stream channel and organic debris structure, deterioration of fish habitat and spawning gravel quality and a complex variety of effects on fish growth and survival. (See also W90-01432) (Author's abstract)
W90-01481

**AQUATIC HUMIC SUBSTANCES: INFLUENCE ON FATE AND TREATMENT OF POLLUTANTS.**
Developed from a symposium sponsored by the Division of Environmental Chemistry of the American Chemical Society and the International Humic Substances Society at the 193rd National Meeting of the American Chemical Society, Denver, Colorado, April 5-10, 1987. American Chemical Society, Washington, DC. 1989. Advances in Chemistry Series no. 219. Edited by I.H. Suffet and Patrick MacCarthy. 864p.

Descriptors: *Wastewater treatment, *Humic acids, *Conferences, *Fate of pollutants, *Water pollution treatment, Water pollution.

Forty-five papers presented at a symposium on the relationship between aquatic humic substances and the fate and treatment of pollutants are included in the volume. The papers are divided into the following categories: Characterization, environmental impacts, interactions in natural waters with organic contaminants, interactions in natural waters with inorganic contaminants, influences of coagulation processes on water treatment, sorption onto activated carbon--influences on water treatment, influences of ozonation and chlorination processes on water treatment, and influences of ion-exchange and membrane processes on water treatment. (See W90-01492 thru W90-01536) (Peters-PTT)
W90-01491

**CHARACTERIZATION OF A STREAM SEDIMENT HUMIN.**
Colorado School of Mines, Golden. Dept. of Chemistry and Geochemistry.
For primary bibliographic entry see Field 2K.
W90-01494

**INTERACTIONS OF HAZARDOUS-WASTE CHEMICALS WITH HUMIC SUBSTANCES.**
Missouri Univ., Columbia. Dept. of Chemistry.
S. E. Manahan.
IN: Aquatic Humic Substances: Influence on Fate and Treatment of Pollutants. American Chemical Society, Washington, DC. 1989. p 83-92, 0 fig, 1 tab, 25 ref.

Descriptors: *Path of pollutants, *Water pollution treatment, *Wastewater treatment, *Hazardous wastes, *Humic acids, *Fulvic acids, *Fate of pollutants, *Chemical precipitation, *Leachates, Chemical reactions, Oxidation, Organic compounds, Aromatic compounds, Hydrocarbons, Heavy metals, Aluminum, Waste disposal, Water pollution prevention, Metals.

Hazardous-waste chemicals may interact in a variety of ways with humic substances. These interactions include solubilization and desolubilization of metal compounds and organic compounds by humic substances, precipitation reactions, and oxidation--reduction phenomena. All three major types of humic substances--fulvic acid, humic acid, and humin--may interact with hazardous-waste chemicals. Among the more important classes of hazardous waste chemicals that may be influenced by the presence of humic substances are sparingly soluble organic compounds, particularly organohalides; polycyclic aromatic hydrocarbons; heavy metal ions; soluble oxidants; iron compounds; aluminum compounds; and strong acids and bases. The interaction of humic substances with hazardous-waste chemical species and the possible uses of humic substances for the treatment of such chemicals is discussed, including the effects of humic substances on hazardous waste leachate treatment. (See also W90-01491) (Author's abstract)
W90-01497

**BINDING OF NONPOLAR POLLUTANTS TO DISSOLVED ORGANIC CARBON: ENVIRONMENTAL FATE MODELING.**
Drexel Univ., Philadelphia, PA. Environmental Studies Inst.
G. Caron, and I. H. Suffet.
IN: Aquatic Humic Substances: Influence on Fate and Treatment of Pollutants. American Chemical Society, Washington, DC. 1989. p 117-130, 3 fig, 32 ref.

Descriptors: *Path of pollutants, *Fate of pollutants, *Dissolved solids, *Organic carbon, *Humic acids, Model studies, Sediments, Solubility, Interstitial water.

Nonpolar compounds associate with organic carbon in the environment. The interaction between pollutants and dissolved organic carbon in natural waters is not as well defined as that between pollutants and sedimentary organic matter. The limitations of experimental techniques and extraction and concentration procedures are partially responsible for the incomplete description of pollutant--DOC (dissolved organic carbon) interactions. Despite the lack of complete understanding of the phenomenon, the association of nonpolar compounds with natural DOC can exert a significant influence on their environmental partitioning. Mathematical models of environmental behavior should include dissolved organic carbon in both overlying and sedimentary interstitial waters as compartments for equilibrium partitioning. (See also W90-01491) (Author's abstract)
W90-01500

**WATER-SOLUBILITY ENHANCEMENT OF NONIONIC ORGANIC CONTAMINANTS.**
U.S. Geological Survey, Denver Federal Center, Denver, CO 80225.
D. E. Kile, and C. T. Chiou.
IN: Aquatic Humic Substances: Influence on Fate and Treatment of Pollutants. American Chemical Society, Washington, DC. 1989. p 131-157, fig 12, tab 5, 37 ref.

Descriptors: *Path of pollutants, *Water chemistry, *Fate of pollutants, *Chemical reactions, *Solubility, *Humic acids, *Organic compounds, Mo-

lecular structure, Mathematical analysis, Fulvic acids, Polychlorinated biphenyls, Hydrocarbons, Temperature effects, Suwannee River, Calcasieu River.

Water-solubility enhancement of selected organic solutes by dissolved organic matter was studied by using a variety of dissolved soil and aquatic humic materials, commercial humic acids, and synthetic organic compounds. The solubility enhancement of relatively water-insoluble solutes (e.g., polychlorinated biphenyls and dichlorodiphenyltrichloroethane) by natural and commercial humic materials is accounted for by a partition-like interaction of the solutes with the nonpolar organic environment of the dissolved organic matter. Solute-solubility enhancement is minimal when poly(acrylic acid) and phenylethanoic acid are used as dissolved organic matter species. The polarity, size, and configuration of the dissolved organic matter and the hydrophilicity of the solute are controlling factors for solubility enhancement. Solubility enhancement is much greater with commercial humic acids than with the aquatic humic materials. (See also W90-01491) (Author's abstract)
W90-01501

**SORPTION OF CHLORINATED HYDROCARBONS IN THE WATER COLUMN BY DISSOLVED AND PARTICULATE ORGANIC MATERIAL.**
Drexel Univ., Philadelphia, PA. Environmental Studies Inst.
L. L. Henry, I. H. Suffet, and S. L. Friant.
IN: Aquatic Humic Substances: Influence on Fate and Treatment of Pollutants. American Chemical Society, Washington, DC. 1989. p 159-171, fig 3, tab 5, 30 ref.

Descriptors: *Path of pollutants, *Water chemistry, *Fate of pollutants, *Chlorinated hydrocarbons, *Sorption, *Humic acids, *Organic compounds, Sediments, Soil types, Leachates, Surface water, Biological magnification, Daphnia, Solubility, Partition coefficients.

Partition coefficients for dissolved and particulate organic material and five organic chemicals were measured in surface waters and leachates from soils and sediments. The partition coefficient for dissolved organic material (Kdom) was measured by using changes in Daphnia magna dry-weight bioconcentration factors, and the partition coefficient for particulate organic material was measured by centrifugation. The results showed that sorption by dissolved organic matter can dominate the distribution of organic chemicals in the water column and affects calculation of the partition coefficient for particulate organic material (Kpom). The linear relationship of log Kdom and log Kpom values to log Kow (octanol-water partition coefficient) was similar to the relationship found by Kenaga and Goring for soils and sediments. This resemblance indicates that organic materials in the water column, soils, and sedimentary material sorb chemicals by a similar mechanism. (See also W90-01491) (Author's abstract)
W90-01502

**CHARGE-TRANSFER INTERACTION BETWEEN DISSOLVED HUMIC MATERIALS AND CHLORANIL.**
State Univ. of New York at Syracuse. Coll. of Environmental Science and Forestry.
M. E. Melcer, M. S. Zalewski, J. P. Hassett, and M. A. Brisk.
IN: Aquatic Humic Substances: Influence on Fate and Treatment of Pollutants. American Chemical Society, Washington, DC. 1989. p 173-183, 6 fig, 27 ref.

Descriptors: *Path of pollutants, *Pesticides, *Humic acids, *Chlorinated hydrocarbons, *Chloranil, *Fate of pollutants, *Chemical reactions, Spectroscopy, Charge transfer, Dissolved solids, Organic compounds.

Using UV-difference spectroscopy, the electron-donating ability of humic materials has been established and a simple, direct method for measuring binding constants has been introduced. Chloranil (2,3,5,6-tetrachloro-p-benzoquinone) was combined with Aldrich humic materials and two dissolved organic matter samples. These mixtures give rise to shifts in the chloranil 290-nm absorption band. Spectra of such solutions versus a chloranil reference contained a negative peak at this wavelength due to the binding interaction. Binding with the Aldrich humic material continued to occur over a period of several weeks. Binding with the dissolved organic materials occurred on the order of a few hours. A charge-transfer mechanism can be postulated for the chloranil-humic system and for similar systems. (See also W90-01491) (Author's abstract)
W90-01503

**SORPTION OF ORGANOCHLORINES BY LAKE SEDIMENT POREWATER COLLOIDS.**
Minnesota Univ., Minneapolis. Dept. of Civil and Mineral Engineering.
P. F. Capel, and S. J. Eisenreich.
IN: Aquatic Humic Substances: Influence on Fate and Treatment of Pollutants. American Chemical Society, Washington, DC. 1989. p 185-207, 5 fig, 5 tab, 71 ref.

Descriptors: *Path of pollutants, *Fate of pollutants, *Chlorinated hydrocarbons, *Humic acids, *Lake sediments, *Interstitial water, Sorption, Polychlorinated biphenyls, Pesticides, Sediments, Colloids, Organic compounds, Diffusion coefficient.

Laboratory and field experiments have shown that distribution coefficients (Kd) for hydrophobic organic compounds (HOC) in sediment-porewater environments are usually in the range of 1000 L/kg. These values are 100-1000 times lower than those normally measured in surface waters or predicted by structure-activity relationships. The reduced KD values are attributed to the sorptive abilities of the organic colloids in the porewater. The sorption of HOC in sediments-porewaters was indirectly studied by examining their diffusion in sediments. The processes of sorption and diffusion are closely related for HOC in sediments. By using an experimental sediment purge setup, effective sediment diffusion coefficients (D eff) of 10 to the minus 8-10 to the minus 12 sq cm/s were obtained for a series of chlorinated pesticides and polychlorinated biphenyl (PCB) congeners differing in their hydrophobicities. Molecular diffusion of dissolved HOC dominates fluxes of compounds with low-to-moderate octanol-water partition coefficients (Kow), whereas colloid-associated HOC may dominate total diffusional fluxes out of sediments for chemicals with a high Kow. (See also W90-01491) (Author's abstract)
W90-01504

**SORPTION OF BENZIDINE, TOLUIDINE, AND AZOBENZENE ON COLLOIDAL ORGANIC MATTER.**
Louisiana State Univ., Baton Rouge. Inst. for Environmental Studies.
J. C. Means, and R. D. Wijayaratne.
IN: Aquatic Humic Substances: Influence on Fate and Treatment of Pollutants. American Chemical Society, Washington, DC. 1989. p 209-222, 6 fig, 2 tab, 20 ref.

Descriptors: *Path of pollutants, *Fate of pollutants, *Estuaries, *Sorption, *Organic compounds, Colloids, Benzidine, Toluidine, Azobenzene, Hydrogen ion concentration, Molecular structure, Thermodynamics.

The sorptive behavior of natural estuarine colloids was investigated with benzidine, toluidine, and azobenzene. In general, the curvilinear equilibrium sorption isotherms were well represented by the Freundlich equation, with 1/n values of 0.72-1.00. Freundlich sorption constants for each aromatic amine, normalized to the organic carbon content of the colloids (Koc), were 3420, 2010, and 1390 at pH 7.9. Sorption was largely controlled by the aqueous-phase pH, with sorption constants increasing as pH decreased to 5. An attempt was made to establish to what extent benzidine, its derivatives, and azobenzene as related to their molecular structure and thermodynamic properties influence the sorptive process. Interpretation of the sorption data allowed certain mechanistic hypotheses to be formulated. An experimental value for o-toluidine water solubility of 75 ppm at pH 7.9 was determined. (See also W90-01491) (Author's abstract)
W90-01505

**EFFECTS OF HUMIC ACID ON THE ADSORPTION OF TETRACHLOROBIPHENYL BY KAOLINITE.**
Michigan Univ., Ann Arbor. Dept. of Chemical Engineering.
G. A. Keoleian, and R. L. Curl.
IN: Aquatic Humic Substances: Influence on Fate and Treatment of Pollutants. American Chemical Society, Washington, DC. 1989. p 231-250, 7 fig, 2 tab, 46 ref.

Descriptors: *Path of pollutants, *Humic acids, *Fate of pollutants, *Polychlorinated biphenyls, *Adsorption, Kaolinite, Chemical reactions, Mathematical analysis, Mathematical models.

Humic acids (HA) can affect the partitioning of organic contaminants between aqueous and sediment phases by complexation in solution and adsorption of the contaminant--HA complex to a mineral surface. The objective of this work was to elucidate these and other mechanisms, using C(14)-radiolabeled 2,2',4,4'-tetrachlorobiphenyl (TeCB), a filtered humic acid preparation, and two natural kaolinites (KGA). The binary interactions, TeCB with KGA, HA with KGA, and TeCB with HA, were studied experimentally at 25 C and pH 6.9. Isotherms were measured for the TeCB-HA-KGA multicomponent system to evaluate adsorption partition coefficients. The data were fitted satisfactorily, within estimated limits of uncertainty, by a model that assumes noncompetitive TeCB and HA adsorption and the same binding constant between free TeCB and dissolved or adsorbed HA. (See also W90-01491) (Author's abstract)
W90-01507

**METHODS FOR DISSOLVING HYDROPHOBIC COMPOUNDS IN WATER: INTERACTIONS WITH DISSOLVED ORGANIC MATTER.**
Manitoba Univ., Winnipeg. Dept. of Soil Science.
G. R. B. Webster, M. R. Servos, G. G. Choudhry, L. P. Sarna, and D. C. G. Muir.
IN: Aquatic Humic Substances: Influence on Fate and Treatment of Pollutants. American Chemical Society, Washington, DC. 1989. p 251-262,3 fig, 3 tab, 32 ref.

Descriptors: *Path of pollutants, *Water chemistry, *Water analysis, *Pollutant identification, *Fate of pollutants, *Solubility, *Hydrophobic compounds, *Dissolved solids, *Humic acids, *Organic matter, Chemical reactions.

Variability inherent in the methods used to dissolve hydrophobic compounds in water is particularly problematic for compounds with solubilities $<1$ mg/L. A number of methods have been described to deal with these problems in both chemical and biological systems. Several methods make use of a generator column or fluidized bed of solid support coated with the hydrophobic compound. Water (the quality of which is often not well defined) or aqueous solutions of dissolved organic matter (DOM) can be pumped through the column or can be used to dilute the saturated solutions for experiments involving biota. Other methods use a variety of direct addition techniques to add either the compound in solution, or the solid or liquid compound itself, to water or aqueous solutions of DOM. These methods are described and critically compared. See also W90-01491) (Author's abstract)
W90-01508

**BIOAVAILABILITY AND TOXICITY OF METALS AND HYDROPHOBIC ORGANIC CONTAMINANTS.**
Oak Ridge National Lab., TN. Environmental Sciences Div.
J. F. McCarthy.
IN: Aquatic Humic Substances: Influence on Fate

and Treatment of Pollutants. American Chemical Society, Washington, DC. 1989. p 263-277, 3 fig, 56 ref.

Descriptors: *Bioavailability, *Toxicity, *Humic acids, *Metals, *Fate of pollutants, *Path of pollutants, *Organic compounds, Amphipods, Daphnia, Fish, Solubility, Hydrophobic compounds, Water pollution effects.

The effect of humic substances on the availability and toxicity of organic and inorganic contaminants in the aquatic environment is reviewed. Organic contaminants associated with humic substances appear to be essentially unavailable for uptake by amphipods, daphnids, and fish. Acute toxicity of these compounds is also diminished proportionally. Because the affinity of organic solutes for binding to humic substances is related to their hydrophobicity, the effect of humic substances is significant only for compounds with octanol-water partition coefficients greater than 10,000. In most cases, association of toxic metals with humic substances reduces the uptake and toxic effects of the contaminants. However, complex interactions among the toxicants, humic ligands, other transition metals and major cations in solution, and the carrier proteins on biological membranes make it difficult to generalize and predict any reduction in accumulation and toxicity of metals. Humic substances may have secondary effects on biota uptake and accumulation of toxicants through their role in altering the transport and fate of pollutants. (See also W90-01491) (Author's abstract)
W90-01509

**GEOCHEMISTRY OF DISSOLVED CHROMIUM--ORGANIC-MATTER COMPLEXES IN NARRAGANSETT BAY INTERSTITIAL WATERS.**
Rhode Island Univ., Narragansett. Graduate School of Oceanography.
For primary bibliographic entry see Field 5A.
W90-01511

**INFLUENCES OF NATURAL ORGANIC MATTER ON THE ABIOTIC HYDROLYSIS OF ORGANIC CONTAMINANTS IN AQUEOUS SYSTEMS.**
Colorado School of Mines, Golden. Dept. of Chemistry and Geochemistry.
D. L. Macalady, P. G. Tratnyek, and N. L. Wolfe.
IN: Aquatic Humic Substances: Influence on Fate and Treatment of Pollutants. American Chemical Society, Washington, DC. 1989. p 323-332, 3 fig, 1 chart, 40 ref.

Descriptors: *Hydrolysis, *Fate of pollutants, *Path of pollutants, *Humic acids, *Organic matter, Organic compounds, Chlorinated pesticides, Dechlorination, Kinetics, Molecular structure.

Investigations that attempt to provide a systematic understanding of the role of natural organic matter in aqueous hydrolytic reactions of anthropogenic organic chemicals are reviewed. In particular, the suggestion that humic substances exert a catalytic effect on a wide variety of hydrolytic reactions is evaluated in the light of experimental evidence. With the possible exception of the hydrolytic dechlorination of the chloro-1,3,5-triazine herbicides, available data do not support the idea of a general catalytic effect. On the contrary, more evidence exists for an inhibitory role than for one of enhancement. The (limited) experimental evidence that may lead to an understanding of the possible role of natural organic matter in mediating abiotic hydrolytic reactions is discussed. Several models that imply a general effect of natural organic matter on the kinetics of hydrolysis are outlined. (See also W90-01491) (Author's abstract)
W90-01512

**SUNLIGHT-INDUCED PHOTOCHEMISTRY OF HUMIC SUBSTANCES IN NATURAL WATERS: MAJOR REACTIVE SPECIES.**
Florida International Univ., Miami. Drinking Water Research Center.
W. J. Cooper, R. G. Zika, R. G. Petasne, and A. M. Fischer.
IN: Aquatic Humic Substances: Influence on Fate and Treatment of Pollutants. American Chemical Society, Washington, DC. 1989. p 333-362, 6 fig, 5 tab, 136 ref.

Descriptors: *Fate of pollutants, *Water chemistry, *Humic acids, *Photochemistry, *Surface water, Oxygen, Chemical reactions, Organic compounds.

The photochemical formation of reactive species, the aqueous electron, singlet oxygen, organoperoxy radicals, hydroxyl radicals, superoxide, hydrogen peroxide, and other phototransients are reviewed, and the effect of these reactive species on the fate of pollutants is discussed. Most likely, the primary source of most of these reactive species is photochemical reactions involving humic substances. (See also W90-01491) (Author's abstract)
W90-01513

**AQUATIC HUMIC SUBSTANCES AS SOURCES AND SINKS OF PHOTOCHEMICALLY PRODUCED TRANSIENT REACTANTS.**
Eidgenoessische Anstalt fuer Wasserversorgung, Abwasserreinigung und Gewaesserschultz, Duebendorf (Switzerland).
J. Hoigne, B. C. Faust, W. R. Haag, F. E. Scully, and R. G. Zepp.
IN: Aquatic Humic Substances: Influence on Fate and Treatment of Pollutants. American Chemical Society, Washington, DC. 1989. p 363-381, 7 fig, 3 tab, 28 ref.

Descriptors: *Water chemistry, *Path of pollutants, *Fate of pollutants, *Photochemistry, *Humic acids, *Nitrates, *Dissolved solids, Organic matter, Surface water, Kinetics, Photoactivation, Degradation, Solar radiation, Chemical reactions.

In sunlit surface waters aquatic humic substances and nitrate act as sensitizers or precursors for the production of photoreactants such as singlet oxygen, humic-derived peroxy radicals, hydrogen peroxide, solvated electrons, and OH radicals. Lifetimes of the various reactants are controlled by their reactions with aquatic humic substances (OH radicals), by solvent quenching (singlet oxygen), by reactions with molecular oxygen (solvated electron), or by other processes (peroxy radicals). The steady-state concentration of each transient formed during solar irradiation was determined from the apparent first-order disappearance rate of added organic probe compounds. The probe compounds used had selective reactivities with the individual transient species of interest. Effects of the photoreactants on the elimination of micropollutants and on chemical transformations of dissolved organic material are discussed. (See also W90-01491) (Author's abstract)
W90-01514

**EVALUATION OF EXTENT OF HUMIC-SUBSTANCE REMOVAL BY COAGULATION.**
Hokkaido Univ., Sapporo (Japan). Dept. of Environmental and Sanitary Engineering.
N. Tambo, T. Kamei, and H. Itoh.
IN: Aquatic Humic Substances: Influence on Fate and Treatment of Pollutants. American Chemical Society, Washington, DC. 1989. p 453-471, 16 fig, 2 tab, 30 ref.

Descriptors: *Water treatment, *Coagulation, *Humic acids, *Organic matter, Alum, Aluminum sulfate, Chromatography, Raw water, Dissolved solids, Water quality.

A functional relationship that quantitatively evaluates the extent of removal of general organic matter from water has been developed, on the basis of gel chromatographic analysis of raw water. This functional relationship was derived by comparison of anion-exchange gel chromatograms before and after coagulation with the water-quality indices of dissolved organic carbon and absorbance at 260 nm. Water quality after coagulation can be predicted by the use of such functions when gel chromatograms of raw water have been evaluated. The mechanism of organic-substance removal by aluminum coagulation is discussed in connection with the extent of removal. (See also W90-01491) (Author's abstract)
W90-01519

**FATE AND REMOVAL OF RADIOACTIVE IODINE IN THE AQUATIC ENVIRONMENT.**
Karlsruhe Univ. (Germany, F.R.). Engler-Bunte Inst.
For primary bibliographic entry see Field 5F.
W90-01526

**QUANTIFICATION OF LONG TERM TRENDS IN ATMOSPHERIC POLLUTION AND AGRICULTURAL EUTROPHICATION: A LAKE-WATERSHED APPROACH.**
Coventry (Lanchester) Polytechnic (England). Dept. of Geography.
I. D. L. Foster, and J. A. Dearing.
IN: The Influence of Climate Change and Climatic Variability on the Hydrologic Regime and Water Resources, International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication No. 168, 1987. p 173-189, 6 fig, 4 tab, 40 ref.

Descriptors: *Air pollution, *Sediment yield, *Paleolimnology, *Limnology, *Agricultural runoff, *Eutrophication, Sedimentology, Cores, Quantitative analysis.

A multiple lake sediment coring exercise applied to two lakes is used to derive historical sediment yield information for the English Midlands since 1765. These data are used in conjunction with chemical extraction techniques to budget atmospherically derived contaminants and agricultural fertilizers accumulating in the lake sediments. Comparison of a semi-natural woodland and an intensively farmed landscape shows that carefully selected lake-watersheds can be used to provide data of sufficient reliability to quantify long term response of the environment to pollution from various sources. It is argued that not only can baseline information be rapidly obtained by careful analysis of lake sediment properties, but that sufficiently long records may be obtained in order to quantify the response to and recovery of an environment from different types of environmental change. It is concluded that the lake-catchment should be recognized as an important hydrological framework for quantitative analysis. (See also W90-01537) (Author's abstract)
W90-01553

**MOBILITY OF RESIDUAL PHASE ORGANICS IN THE VADOSE ZONE.**
Waterloo Univ. (Ontario). Dept. of Civil Engineering.
B. E. Sleep, and J. F. Sykes.
IN: Unsaturated Flow in Hydrologic Modeling: Theory and Practice. Kluwer Academic Publishers, Boston. 1989. p 489-498, 9 fig, 16 ref.

Descriptors: *Soil water, *Path of pollutants, *Volatile organic compounds, *Saturated soils, *Model studies, *Vadose zone, Groundwater pollution, Volatility, Chlorinated hydrocarbons, Residual organic compounds.

A model was developed to characterize the transport of volatile organics in variably saturated media. Water phase flow and transport and density dependent gas phase flow and transport were simulated. First order rate expressions using overall rate transfer coefficients were employed to incorporate dissolution and volatilization of immobilized residual organic compounds. Partitioning of solute between the water and gas phases was represented by a similar rate expression based on Henry's law. The role of the soil gas phase in increasing subsurface contamination from volatile organics, and in dissipating residual amounts of these compounds was illustrated. (See also W90-01590) (Author's abstract)
W90-01610

**DUTCH NATIONAL RESEARCH PROGRAMME ON SEWERAGE AND WATER QUALITY.**
For primary bibliographic entry see Field 5G.
W90-01640

**PHOSPHORUS CONTENT OF STORMWATER RUNOFF.**
Karlsruhe Univ. (Germany, F.R.). Inst. fuer Siedlungswasserwirtschaft.
C. Xanthopoulos, and H. H. Hahn.
IN: Hydrological Processes and Water Management in Urban Areas. Proceedings of the International Symposium 24-29 April 1988, Duisburg, West Germany. International Hydrological Programme of UNESCO Publication, 1988. p 381-389, 3 tab, 8 ref.

Descriptors: *Urban runoff, *Storm runoff, *Phosphorus, *Water pollution sources, *Urban drainage, Surface runoff, West Germany, Municipal wastewater, Wastewater treatment, Sewers, Path of pollutants, Drainage systems, Combined sewer overflows, Water storage.

The intensification of wastewater treatment in central municipal treatment plants has led to a significant reduction of pollution of surface waters in the Federal Republic of Germany. Stormwater runoff, introduced into the receiving water through stormwater sewers of separate systems or through stormwater discharges from combined sewer systems (CSOs), contribute to the pollution of surface waters more frequently, as the remaining load from wastewater plants is reduced. Therefore, present pollution control focuses on the proper routing and treatment of stormwater runoff. The majority of urban drainage systems in the Federal Republic of Germany, consist of CSOs; the presently favored concept of pollution control entails the construction of storage space for highly polluted storm water runoff and subsequent treatment of this very polluted fraction of the total runoff in the municipal treatment plant. Many such systems are under construction and in some instances intensive measurement programs are under way. It remains to be seen how effective this concept really is. Storm water runoff modeling on the basis of accurate data for calibration and verification may become a powerful tool in deciding on the actual efficiency (with respect to type, size and location) of such stormwater storage basins. (See also W90-01612) (Lantz-PTT)
W90-01655

**INFLUENCE OF INDUSTRIALIZATION AND HYDROGEOLOGY ON THE QUALITY OF GROUND AND SURFACE WATER IN BIELEFELD (CASE STUDIES).**
M. Dummer, and L. Van Straaten.
IN: Hydrological Processes and Water Management in Urban Areas. Proceedings of the International Symposium 24-29 April 1988, Duisburg, West Germany. International Hydrological Programme of UNESCO Publication, 1988. p 421-428, 4 fig, 2 tab, 7 ref.

Descriptors: *Water pollution sources, *Water pollution treatment, *Industrial development, *Geohydrology, *Groundwater quality, *West Germany, *Urban areas, Bielefeld, Groundwater pollution, Leachates, Landfills.

The town of Bielefeld, West Germany, has developed into an important industrial center since the middle of the last century. This has influenced the quality of ground and surface water. Surveys of dumps, abandoned dumps and cases of groundwater contamination by hazardous substances, reveal the importance of geohydrological conditions. Extensive contaminant plumes are only to be found in the groundwater of the Senne sands to the southwest of Bielefeld, originating from the handling of solvents and leachate from an operational dump. In the Herford Lias Basin area, the surface water is more endangered. Here, the effects of household sewage can be greater than those of dump leachate. The costs for abandoned dump surveys to establish the degree of danger, and plans for and actual remedial measures conducted between 1985 and 1987, ran more than 8 million DM. (See also W90-01612) (Lantz-PTT)
W90-01659

**EFFECT OF URBANIZATION ON A SHALLOW QUATERNARY AQUIFER.**
Technische Univ. Muenchen (Germany, F.R.). Lehrstuhl fuer Hydrogeologie und Hydrochemie.
For primary bibliographic entry see Field 4C.
W90-01664

**EFFECT OF URBANIZATION ON THE HYDROLOGICAL SYSTEM AND WATER QUALITY.**
Warsaw Univ. (Poland).
For primary bibliographic entry see Field 4C.
W90-01665

**IMPACT OF AN URBAN AREA ON THE HYDROCHEMISTRY OF A SHALLOW GROUNDWATER (ALLUVIAL RESERVOIR) TOWN OF NARBONNE, FRANCE.**
Montpellier-2 Univ. (France). Lab. d'Hydrogeologie.
For primary bibliographic entry see Field 4C.
W90-01667

**IMPACTS OF URBANIZATION OF THE GREATER CAIRO AREA ON THE GROUND WATER IN THE UNDERLYING AQUIFER.**
International Inst. for Hydraulic and Environmental Engineering, Delft (Netherlands).
For primary bibliographic entry see Field 4C.
W90-01670

**RAPID REMOVAL OF WATER: A DANGER FOR ALL BODIES OF WATER.**
Emschergenossenschaft und Lippeverband, Essen (Germany, F.R.).
I. V. Stalmann.
IN: Hydrological Processes and Water Management in Urban Areas. Proceedings of the International Symposium 24-29 April 1988, Duisburg, West Germany. International Hydrological Programme of UNESCO Publication, 1988. p 533-541, 8 fig.

Descriptors: *Urban runoff, *Water management, *Surface water, *Seepage control, Rivers, Rainfall intensity, Groundwater recharge, Overflow.

Rain water discharge from mixed sewerage, affects the quality of even larger rivers. Rain water treatment is one method for coping with this problem. Seepage, can also reduce a large quantity of rain water. Small streams suffer most from an excess of rain water discharge. Instead of applying measures to increase the flow capacity of the streams, a reduction of flow by seepage in suburban areas, should be considered. This would benefit groundwater renewal, increase the base flow in the streams, require a smaller sewage system, and cause fewer problems with untreated sewage overflows at treatment plants. (See also W90-01612) (Lantz-PTT)
W90-01672

**EFFECTS OF URBANIZATION ON WATER RESOURCES IN THE WATERFORD RIVER BASIN.**
Newfoundland Dept. of the Environment, St. John's.
For primary bibliographic entry see Field 4C.
W90-01674

**HYDROLOGICAL IMPACT OF URBANIZATION--A STUDY OF THE PALMIET RIVER IN METROPOLITAN DURBAN, SOUTH AFRICA.**
Durban-Westville Univ. (South Africa). Dept. of Geography.
For primary bibliographic entry see Field 4C.
W90-01676

**GROUNDWATER POLLUTION BY TILBURG'S GAS PLANT.**
Iwaco B.V., Boxtel (Netherlands).
For primary bibliographic entry see Field 4C.
W90-01677

**IMPACTS ON GROUNDWATER QUALITY AND GROUNDWATER USE IN A HIGH POPULATED AND INDUSTRIALIZED URBAN REGION.**
Technologieberatung Grundwasser und Umwelt Koblenz, West Germany.
For primary bibliographic entry see Field 4C.
W90-01680

**CHEMICAL AND BIOLOGICAL IMPACT OF COMBINED SEWER OVERFLOWS UPON A WATER REGULATION DITCH TYPICAL FOR URBANIZED AREAS IN THE NETHERLANDS.**
Rijksinstituut voor de Volksgezondheid en Milieuhygiene, Bilthoven (Netherlands).
For primary bibliographic entry see Field 4C.
W90-01681

**WATER AND THE URBAN LANDSCAPES IN THE TROPICS: THE EXAMPLE OF LAGOS, NIGERIA.**
Lagos Univ. (Nigeria). Dept. of Geography.
For primary bibliographic entry see Field 3C.
W90-01689

**GROUNDWATER CONTAMINATION: SOURCES, CONTROL, AND PREVENTIVE MEASURES.**
Albuquerque City Enviromental Compliance Dept., NM.
For primary bibliographic entry see Field 5G.
W90-01704

**LACKAWANNA RIVER PRIORITY WATER BODY SURVEY REPORT WATER QUALITY STANDARDS REVIEW.**
Susquehanna River Basin Commission, Harrisburg, PA.
For primary bibliographic entry see Field 5G.
W90-01705

**INSTALLATION RESTORATION PROGRAM. STAGE 3: MCCLELLAN AIR FORCE BASE, SEMIANNUAL INFORMAL TECHNICAL REPORT.**
Radian Corp., Sacramento, CA.
For primary bibliographic entry see Field 5G.
W90-01707

**MODELING GROUNDWATER TRANSPORT OF DISSOLVED GASOLINE.**
Argonne National Lab., IL.
S. C. L. Yin.
Available from the National Technical Information Service, Springfield, VA 22161, as DE88-011981. Price codes: A02 in paper copy, A01 in microfiche. Report No. CONF-880741--4, (1988). 8p, 3 fig, 1 tab, 12 ref. DOE Contract W-31-109-Eng-38.

Descriptors: *Groundwater movement, *Gasoline, *Path of pollutants, *Model studies, Solute transport, Hydrologic models, Aquifers, Groundwater pollution, Benzene, Xylene, Organic compounds, Hydraulic conductivity, Cleanup operations.

A solute transport model was used to simulate aquifer restoration processes for groundwater contaminated by dissolved gasoline. The simulation results were used to evaluate the feasibility and effectiveness of aquifer restoration by pumping out the contaminated water. The aquifer restoration process consists of a single well, located at the center of the contaminated area, that pumps the groundwater at constant rates of 400, 50, and 5 gallons per minute (gpm) for three aquifers with hydraulic conductivities of 5000, 500, and 50 gallons per day/sq ft (gpd/sq ft), respectively. The pumping rates were selected so that the maximum well drawdown, after 20 years of pumping, in all three cases is about one half of the aquifer thickness. The modeling results indicate that the time of pumping required to reduce concentrations of benzene and xylene to acceptable levels is likely to be

many years. Even for the case with the highest hydraulic conductivity, it would take 4 and 12 years, respectively, to reduce benzene and xylene concentrations to 10 parts per billion. In general, the pumping periods required are sensitive to hydraulic conductivity of the aquifer and retardation factors of the hydrocarbons. (Author's abstract)
W90-01710

**SUPERFUND RECORD OF DECISION: AMERICAN THERMOSTAT, NY.**
Environmental Protection Agency, Washington, DC. Office of Emergency and Remedial Response.
For primary bibliographic entry see Field 5G.
W90-01712

**SUPERFUND RECORD OF DECISION: YORK OIL COMPANY, NY.**
Environmental Protection Agency, Washington, DC. Office of Emergency and Remedial Response.
For primary bibliographic entry see Field 5G.
W90-01714

**DATA SUMMARY FOR TRINITROTOLUENE.**
Army Medical Research and Development Command, Fort Detrick, MD.
For primary bibliographic entry see Field 5A.
W90-01716

**SUPERFUND RECORD OF DECISION: EAU CLAIRE MUNICIPAL WELL, WI.**
Environmental Protection Agency, Washington, DC. Office of Emergency and Remedial Response.
For primary bibliographic entry see Field 5G.
W90-01717

**SUPERFUND RECORD OF DECISION: L.A. CLARKE AND SON, VA.**
Environmental Protection Agency, Washington, DC. Office of Emergency and Remedial Response.
For primary bibliographic entry see Field 5G.
W90-01718

**TEMPORAL TRENDS OF CONTAMINANTS RECORDED IN SEDIMENTS OF PUGET SOUND.**
Battelle Pacific Northwest Labs., Richland, WA.
E. A. Crecelius, and H. C. Curl.
Available from the National Technical Information Service, Springfield, VA 22161, as DE88-008204. Price codes: A03 in paper copy, A01 in microfiche. Report No. PNL-SA--15399, March 1988. 11p, 4 fig, 21 ref. DOE Contract DE-AC06-76RL0 1830.

Descriptors: *Path of pollutants, *Washington, *Fate of pollutants, *Sediment contamination, *Puget Sound, Chemical analysis, History, Heavy metals, Organic compounds, Synthetic compounds, Arsenic, Cadmium, Copper, Zinc.

Puget Sound has been used as a waste disposal site for more than 100 years. The residence time (flushing rate) for seawater in the Sound is about half a year, while the residence time of particles in the water column is generally less than a month. Some of the contaminants discharged to the Sound are either attached to particulate matter or sequestered by suspended sediments and thus accumulate in the fine-grain sediments. Those contaminants that tend to remain dissolved in seawater, such as arsenic (As), cadmium (Cd), copper (Cu), and zinc (Zn), are transported out of Puget Sound into the Pacific Ocean. The temporal trends of contamination of central Puget Sound inferred from the chemical composition of age-dated sediment cores, indicate heavy metal and hydrocarbon contamination began in the late 1800s, reached a maximum in the mid-1900s and has begun to decrease in the last decade. Synthetic organics first appear in sediments deposited in the 1930s and reach a maximum in the 1950s. Because of the relatively rapid flushing rate and rapid sedimentation rate in Puget Sound, changes in contaminant loading will result in relatively rapid changes in surficial sediment quality. (Lantz-PTT)
W90-01721

**CHEMICAL CHARACTERISTICS OF STREAMS IN THE MID-ATLANTIC AND SOUTHEASTERN UNITED STATES (NATIONAL STREAM SURVEY-PHASE I). VOLUME I: POPULATION DESCRIPTIONS AND PHYSICO-CHEMICAL RELATIONSHIPS.**
Environmental Protection Agency, Washington, DC. Office of Acid Deposition, Environmental Monitoring, and Quality Assurance.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-119806. Price codes: A18 in paper copy, A01 in microfiche. Report No. EPA/600/3-88/021a, June 1988. 397p, 134 fig, 45 tab, 186 ref, 4 append. EPA Contracts 68-03-3249 and 68-02-3889.

Descriptors: *Data collections, *Water chemistry, *Sulfates, *Acid rain, *Streams, *Water quality, Acidic water, Chemical analysis, Hydrogen ion concentration, Water pollution sources.

National Stream Survey Phase I (NSS-I) field activities were conducted in the Mid-Atlantic and Southeastern U.S. in the spring of 1986 by the US EPA as part of the National Surface Water Survey and the National Acid Precipitation Assessment Program. The Survey employed a probability sample of 500 stream reaches representing a region population of 64,700 reaches portrayed as blue lines on 1:250,000 scale maps and which have drainage areas $<$ 155 sq km. The NSS-I design allows regional extrapolation, with known confidence, of the number and total length of reaches with specified chemical characteristics. Excluding Florida, the Southeastern subregions of the NSS-I were estimated to contain very few acidic reaches. Acidic reaches were found primarily in lowland reaches of Florida and the Mid-Atlantic Coastal Plain and in upland reaches of the Mid-Atlantic subregions. Sulfate concentrations were markedly higher in the Mid-Atlantic than in the Southeast. Acidic reaches were classified according to probable sources of acidic ions. Analysis of ion composition and evidence of stream acidification are presented. (Author's abstract)
W90-01727

**MONTHLY RESULTS OF MEASUREMENTS, JULY 1987 (TABLEAUX MENSUELS DES MESURES).**
Available from National Technical Information Service, Springfield, VA 22161 as DE88751857/GAR, Price codes: A04 in paper copy, A01 in microfiche. Report SCPRI-RM-7-1987, August 1987. 54p, 20 ref. In French.

Descriptors: *Nuclear powerplants, *Path of pollutants, *Monitoring, *Radioactive wastes, *France, Dusts, Rainwater, Surface water, Groundwater, Drinking water, Effluents, Food chains, Sediments.

This report of the SCPRI is an interpretation of the principal results concerned with the monitoring of the path of environmental radioactivity in France: atmospheric dusts, rainwater, surface waters, underground water, drinking water, sewage water, food chain (milk, vegetables, fishes), seawater around nuclear plant sites and other sites, and sediments. The activities of various radioisotopes are presented in tables. The results of special radiation measurements resulting from the Chernobyl accident are also reported. (Author's Abstract)
W90-01731

**MODELING ESTIMATION OF THE DISTRIBUTION AND FATE FOR CHEMICALS IN THE ENVIRONMENT (MODELLHAFTE ERFASSUNG UND VORHERSAGE DER VERTEILUNG UND DES VERBLEIBS VON VERBRAUCHSCHEMIKALIEN IN DER UMWELT).**
Umweltbundesamt, Berlin (Germany, F.R.).
R. Frank, W. Kloepffer, G. Rippen, and W. Ulrici.
Available from National Technical Information Service, Springfield, VA 22161 as TIB/A87-80529, Price codes: E07 in paper copy. Contract UFOPLAN-Nr. Report UBA-FB--84-122. December 1984. 235p, 13 fig, 32 tab, 157 ref. English summary.

Descriptors: *Path of pollutants, *Fate of pollutants, *Model studies, Sensitivity analysis, Chemical analysis.

A comparison between the Environmental Model Segment Approach (EMSA) and other models, a sensitivity analysis of EMSA and a verification of the terms used in these models is presented. The applicability of EMSA is shown for 26 substances. A new approach for estimating the environmental concentrations of substances which are primarily released to the water compartment is also developed. Part II describes some approaches for deriving environmentally important properties like use pattern, release pattern, production volume, etc., from the structural formula of a chemical compound. However, these approaches have not yet been fully developed. (Author's abstract)
W90-01737

**SPREADING OF HAZARDOUS SUBSTANCES IN THE SOUTHERN GERMAN BAY AND THE ELBE-ESTUARY AFTER DISCHARGE FROM SHIPS. AN ECOLOGICAL RISK ASSESSMENT BY NUMERICAL MODEL CALCULATIONS (AUSBREITUNG VON WASSERGEFAHRDENDEN STOFFEN IN DER SUDLICHEN DEUTSCHEN BUCHT UND IM ELBE-ASTUAR NACH FREISETZUNG DURCH SCHIFFE).**
K. C. Duwe, J. Krohn, K. D. Pfeiffer, J. C. Reidel-Lorfe, and K. C. Soetje.
Available from National Technical Information Service, Springfield, VA 22161 as DE88750006/GAR, Price codes: A05 in paper copy, A01 in microfiche. Report GKSS-87/E/18. 1987. 81p, 25 fig, 34 ref. English summary.

Descriptors: *Hazardous materials, *Path of pollutants, *Fate of pollutants, *Accidents, *West Germany, Ships, Safety, Model studies, Tracers, North Sea, Elbe estuary, Distribution.

Based on realistic assumptions about accidents of ships carrying dangerous goods, the spreading of released substances is estimated with numerical models and the ecological consequences are investigated. Three locations have been chosen that constitute different biotopes and are distinguished by frequent shipping; the inner German Bight of the North Sea and the lower Elbe estuary in the brackish water zone and the fresh water zone. The spreading of substances is simulated by a tracer method that is based on the results of three-dimensional baroclinic and barotropic North Sea and estuary models. The high temporal and spatial variability of the flow field causes small differences in the point of release to yield large variations in the concentration distribution. (Author's abstract)
W90-01738

**ION BALANCE IN FOREST ECOSYSTEMS (IONBALANCE I SKOV-KOSYSTEMER).**
Miljoestyrelsen, Roskilde (Denmark). Luftforureningslaboratoriet.
For primary bibliographic entry see Field 2K.
W90-01739

**SURVEY ON THE EFFECT OF THE DISCHARGE OF WASTE FROM TITANIUM DIOXIDE PRODUCTION IN THE GERMAN BAY (HELIGOLAND BAY). (UEBERBLICK UEBER AUSWIRKUNGEN DER VERKIAPPUNG VON ABFAELLEN AUS DER TITANDIOXIDPRODUKTION IN DER DEUTSCHEN BUCHT).**
Bundesforschungsanstalt fuer Fischerei, Hamburg (Germany, F.R.). Inst. fuer Kuesten- und Binnenfischerei.
V. Dethlefsen.
Available from National Technical Information Service, Springfield, VA 22161 as TIB/B87-81482/GAR, Price codes: E07 in paper copy. Report no. 95/1986. 1986. 45p, 19 fig, 3 tab, 48 ref, append. In German.

Descriptors: *Water pollution sources, *Industrial wastes, *Titanium dioxide, *Fish physiology, *West Germany, *Water pollution effects, Water pollution control.

Since 1969, between 450,000 and 750,000 tons per annum of waste from titanium dioxide production has been discharged in a sea area 12 nautical miles northwest of Heligoland. Increased heavy metal contents can be demonstrated in the seawater, sediment and in the outer textures of the fishes (Limanda limanda). Fishes from the immediate vicinity of the discharge area for waste from titanium dioxide production showed increased frequencies of skin tumors and epidermal papilloma. As one cannot exclude that there is a causal connection between the occurrence of increased rates of illness and the dumping of waste in the sea area of the central German Bay (Heligoland Bay), the authorities responsible for waste disposal in West Germany decided that this discharge should be reduced step by step, so that it would finally be ended in the year 1989. (Author's abstract)
W90-01744

**POLYURETHANE FLEXIBLE FOAM OIL BARRIER PRODUCTION SYSTEM FOR THE PROTECTION OF HARBOURS, SHORELINES, AND AQUACULTURE PROJECTS (BARRIERE AUS POLYURETHANWEICHSCHAUM ZUM SCHUTZ GEGEN AUSLAUFENDES ROHOL BEI TANKER-HAVARIEN BZW. SUM SCHUTZ VON HAFEN, STRANDEN UND AQUAKULTURANLAGEN).**
Aqua-Physik Dr. Dietzel, Krefeld (Germany, F.R.).
K . Dietzel.
Available from National Technical Information Service, Springfield, VA 22161 as DE87753271/GAR, Price codes: A04 in paper copy, A01 in microfiche. Report NP-7753271. 1987. 51p, 6 fig, 1 table, append. English summary.

Descriptors: *Oil spills, *Oil pollution, *Cleanup operations, *Barriers, Oil tankers.

Among several sponsored projects concerning the combat of oil pollution a method and a prototype of an oil barrier production system has been developed. This method produces a continuous barrier of flexible polyurethane foam at any length needed at the place of an oil spill, off board a ship, for the protection of harbors, shorelines or aquaculture facilities. The modulus system permits units of any size needed to be built. The production speed of a barrier is independent of temperatures and weather conditions, 250-400 meters per hour; a method and a prototype of a semiautomatic sewing device for the production of the skin, surrounding the floating element made up of flexible polyurethane foam. The production speed for this type of skin is about 1200 meters a day (24 working hours per day). (Author's abstract)
W90-01747

**FACTORS AFFECTING THE OCCURRENCE OF THE LEGIONNAIRES' DISEASE BACTERIUM IN PUBLIC DRINKING WATER SUPPLIES.**
Pittsburgh City Water Dept. PA.
For primary bibliographic entry see Field 5F.
W90-01756

**PATHWAYS FOR THE PRODUCTION OF ORGANOCHLORINE COMPOUNDS IN THE CHLORINATION OF HUMIC MATERIALS.**
Technische Hogeschool Delft (Netherlands). Lab. for Analytical Chemistry.
For primary bibliographic entry see Field 5F.
W90-01758

**SOME LIPOPHILIC COMPOUNDS FORMED IN THE CHLORINATION OF PULP LIGNIN AND HUMIC ACIDS.**
Svenska Traeforskningsinstitutet, Stockholm.
A. B. McKague, and K. P. Kringstad.
IN: Biohazards of Drinking Water Treatment, Lewis Publishers, p 123-131, 1989. 5 fig, 2 tab, 23 ref.

Descriptors: *Water pollution sources, *Pulp wastes, *Kraft mills, *Bleaching wastes, *Humic acids, *Organic compounds, *Chlorination, *Water treatment, Drinking water, Potable water, Fatty acids, Lipids, Chemical degradation, Chemical properties.

Lipophilic compounds, which have high solubility in fat and low solubility in water, have been found to persist for many years and to accumulate in aquatic organisms and sediments. In Sweden, a number of steps have been taken to reduce the discharge of chlorinated organics from the pulp industry. Because of the similarity in the nature of pulp lignin and humic acid and the possibility traces of chlorinated lipophilic compounds may be present in drinking water, work has been done to identify some new chlorinated furanones and has revealed some previously unrecognized degradation pathways for lignin and humic acid. For the identification of lipophilic compounds in spent bleach liquors, lipophilic material wa concentrated by preparative reverse-phase thin layer chromatography (RPTLC). Lipophilic material was analyzed by gas chromatography with electron capture and mass spectrometry. At least 20 lipophilic chlorinated compounds were detected in the spent beach liquor, including furanones 2a, 2b and 3. Subsequent analysis of spent chlorination liquor from a Swedish pulp mill showed significantly smaller, but still detectable, amounts of these compounds. Traces of furanones 1-3 were detected by gas chromatography/ECD when humic acid was chlorinated under different pH conditions at a carbon concentration of 70 mg/L using a Cl2:C ratio of 4:1. The effect of pH was most clearly seen in the case of the two major compounds 1 and 2b. The chlorinated furanones formed only in trace amounts during the chlorination of softwood kraft pulp and humic acid. Even small quantities were found in the case of pulp bleaching. Although it is unlikely the furanones found in this study constitute an environmental hazard in receiving waters, their significance with respect to drinking water is unknown. (See also W90-01750) (Friedmann-PTT)
W90-01760

**MULTICOMPARTMENT MODEL OF SUSPENDED MATTER TRANSPORT IN SURFACE BODIES OF WATER (MULTIKOMPARTIMENT-MODELL FUR DEN TRANSPORT VON STOFFEN IN OBERFLAECHENGEWAESERN).**
Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.). Projektgruppe Umweltgefaehrdungsponteniale von Chemikalien.
R. Brueggemann, and B. Muenzer.
Available from National Technical Information Service, Springfield, VA 22161 as DE88754300, Price codes: E14 in paper copy. Report GSF-33/87, December 1987. 152p, 28 fig, 25 tab, 45 ref. In German.

Descriptors: *Path of pollutants, *Solute transport, *Model studies, *Sediment transport, Flow characteristics, Flow profiles, Suspended solids, Chemical transport, Mixing.

The EXWAT model describes typical processes in flowing bodies of water, e.g. volatilization, sorption to suspended matter sorption to the sediment matrix, degradation reactions, transport in the form of dissolved particles, transport in the form of particles bound to suspended matter, and stratification processes in the sediment layer. The model describes a segment of river through which water flows at a given volume flow rate. The segment comprises two compartments, i.e. a fluid compartment containing the moving water and suspended matter, and the sediment compartment consisting of pores and a solid matrix which is assumed to be stationary. The sediment compartment in the model consists only of the top sediment layer, which is considered to be well mixed. The fate of a chemical substance in the deeper sediment layers is described by the sediment stratification rate. The descriptors used in EXWAT, as in the other submodels of E4CHEM, take into account the hazardousness specifications of the Chemical Substances Act. (Author's Abstract)
W90-01775

**EXTINT--COMBINATION OF THE SINGLE-MEDIUM MODELS EXSOL, EXWAT, AND EXAIR TO A MULTI-MEDIA MODEL (EXTINT--VERKNUEPFUNG DER SINGLE-MEDIUM-MODELLE EXSOL, EXWAT, UND EXAIR ZU EINEM MULTI-MEDIA-MODELL).**
Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.). Projektgruppe Umweltgefaehrdungsponteniale von Chemikalien.
R. Trenkle, B. Muenzer, M. Matthies, and R. Brueggemann.
Available from National Technical Information Service, Springfield, VA 22161 as TIB/B88-80840/GAR, Price codes: E09 in paper copy. UFOPLAN-Nr Contract. Report GSF-32/87, December 1987. 62p, 9 fig, 3 tab, 5 ref. English summary.

Descriptors: *Fate of pollutants, *Path of pollutants, *Hazardous materials, *Mathematical models, Soil, Water, Air, Chemical composition.

Mathematical models which consider the most relevant environmental transport and transformation processes, were developed for the description of the environmental fate of chemicals. Three models regarding the behavior in soil (EXSOL), surface waters (EXWAT) and lower troposphere (EXAIR) together with another model (EXINT) which describes the exchange processes between these three media form the core of a system for exposure estimations. Two further models are available for special situations. For estimating ecotoxicological effects, use is made from toxicological single-species-tests (ETTOX). The release from the technosphere into the three media; soil, water and air is determined from the production volume and the use pattern (RLTEC). Environmental hazard potentials are derived from release, fate and effect potentials, and applied to priority setting among existing chemicals. For this purpose, the models and the decision aids are combined in a computer program E4CHEM (Exposure and Ecotoxicity Estimation for Environmental CHEMicals). By means of E4CHEM, descriptors of the environmental hazard are calculated from substance data with predetermined environmental conditions. The descriptors are defined in order to correspond with the selection criteria of the German Chemicals Act. The final results of the calculations are lists of chemicals in the order of increasing hazard. (Author's Abstract)
W90-01781

**SCIENTIFIC-TECHNICAL DEMANDS FOR THE SANITATION OF CONTAMINATED SITES--PART I: WORKING-OUT A VALUATION SCHEME FOR MIGRATION BEHAVIOR OF SUBSTANCES UNDERGROUND (NATURWISSENSCHAFTLICH-TECHNISCHE ANFORDERUNGEN AN DIE SANIERUNG KONTAMINIERTER STANDORT--TEIL I: ERARBEITUNG EINES SCHEMAS ZUR BEWERTUNG DES MIGRATIONSVERNALTENS VON STOFFEN IM UNTERGRUND).**
Umweltbundesamt, Berlin (Germany, F.R.).
T. Darimont.
Available from National Technical Information Service, Springfield, VA 22161 as TIB/A87-80469/GAR, Price codes: E07 in paper copy. Contract UFOPLAN-Nr. Report UBA-FB-85-045/1. April 1985. 149p, 55 fig, 16 tab, 121 ref. English summary.

Descriptors: *Path of pollutants, *Groundwater pollution, *Water pollution control, *Water pollution prevention, Model studies, Chemical transport.

According to their behavior underground, different water-endangering substances result in different dangers. Following the biological-toxic evaluation of water-endangering substances, a general substance specific behavior evaluation model was developed. The most important premise is the restriction of the various physio-chemical data to a pragmatic manageable system. Preventive measures are necessary to protect the groundwater. A generalized behavior valuation model presents a basis on which to formulate an appropriately graded category of technical and administrative demands to this purpose. (Author's Abstract)
W90-01791

**LEACHING OF METALS FROM PEAT FLY ASHES (UTLAKNING AV METALLER UR TORVFLYGASKA).**
Valtion Teknillinen Tutkimuskeskus, Espoo (Finland).
M. Wahlstrom, and V. Pohjola.
Available from National Technical Information Service, Springfield, VA 22161 as DE88751090/GAR, Price codes: A07 in paper copy. Report VTT-TUTK-483. May 1987. 149p, 23 fig, 32 tab, 12 ref, 6 append. English summary.

Descriptors: *Water pollution sources, *Fly ash, *Leaching, *Landfills, Peat fly ash, Coal fly ash, Chemical analysis, Solubility, Toxicity, Column tests, Lysimeter tests, Batch tests.

The long term impact from fly ash on a landfill was studied by using batch leaching tests, column leaching tests, and large scale lysimeter leaching tests. The study used also ecotoxicological testing of the leachates. The water-soluble part of the fly ashes was about 2 to 3 per cent. The major components of the leachates were sulfate, potassium, sodium, calcium and chloride. Only small amounts of trace elements, mainly arsenic, molybdenum, and iron, were leached. No substantial difference between the two types of fly ashes (peat and coal) was noticed. The water-soluble amounts of the trace elements varied strongly for the different fly ashes. The pH-values of the leachates were neutral or alkaline and remained constant during the shake procedure. The concentrations in leachates decreased rapidly as a function of the increase of leaching water to the columns and the lysimeters. The leachates from the columns and lysimeters showed very small toxic effects in the ecotoxicological tests. The toxic effects were highest in the initial leachate fractions. The leaching behavior, especially in the column leaching test and the lysimeter leaching test, was similar for the fly ashes. The results from the batch leaching test, which gave less detailed information on the leaching behavior, agreed well with the results from the column leaching test and the lysimeter leaching test. This indicates that laboratory tests, i.e. batch and column tests, can well be used to predict the leaching of components from fly ashes. (Author's Abstract)
W90-01792

**INVESTIGATION OF THE MIGRATION OF HARMFUL ORGANIC SUBSTANCES THROUGH MINERAL SEALS BY MEANS OF RADIOACTIVE TRACERS (UNTERSUCHUNG DER MIGRATION VON ORGANISCHEN SCHADSTOFFEN DURCH MINERALISCHE DICHTUNGEN MITTELS RADIOAKTIVER TRACER).**
Ruhr Univ., Bochum (Germany, F.R.). Lehrstuhl fuer Grundbau und Bodenmechanik.
H. L. Jessberger, and J. Buderus.
Available from National Technical Information Service, Springfield, VA 22161 as DE88751233/GAR, Price codes: A08 in paper copy, A01 in microfiche. Report NP-8751233. December 1986. 160p, 31 fig, 8 tab, 15 ref, 15 append.

Descriptors: *Radioactive tracers, *Waste disposal, *Groundwater pollution, *Leachates, *Landfills, *Sealants, Silt, Bentonite, Autoradiography, Resolving counter.

In the basic sealing of deposits of rubbish, the long term chemical stability of the clay minerals used and the pore cements to chemical solutions is the decisive factor for sealing against groundwater. Two different mineral sealing materials were selected, a natural silt soil and a bentonite cement/sand mixture, in order to examine the effects on the flow values of organic test liquid for the samples. The integration behavior was observed by means of radioactive tracers, where, in order to measure the distribution of radioactivity, an auto-radiographic method and an evaluation using a local resolving counter tube were used. (Author's Abstract)
W90-01793

**WARNING SYSTEM COMPATIBLE WITH RANDOMLY TIMED POLAR SATELLITES: DEVELOPMENT ALTERNATIVES FOR OIL SPILL WARNING SYSTEMS.**
Vizgazdalkodasi Tudomanyos Kutato Intezet, Budapest (Hungary).
For primary bibliographic entry see Field 7B.
W90-01822

## 5C. Effects Of Pollution

**CHANGES IN STRATIFICATION IN ONONDAGA LAKE, NEW YORK.**
Massachusetts Inst. of Tech., Cambridge. Ralph M. Parsons Lab.
For primary bibliographic entry see Field 2H.
W90-00974

**EFFECTS OF FOREST HERBICIDE APPLICATIONS ON STREAMWATER CHEMISTRY IN SOUTHWESTERN BRITISH COLUMBIA.**
British Columbia Univ., Vancouver. Faculty of Forestry.
M. C. Feller.
Water Resources Bulletin WARBAQ, Vol. 25, No. 3, p 607-616, June 1989. 2 fig, 4 tab, 21 ref.

Descriptors: *Water pollution effects, *Path of pollutants, *Herbicides, *Forest management, *Streams, *Glyphosate, Secondary effects, Nitrates, Phosphates, Sulfates, Ammonia, Sodium, Potassium, Calcium, Chlorides, Silica.

The herbicide glyphosate was applied to portions of two watersheds in southwestern British Columbia to kill vegetation that was competing with Pseudotsuga menziesii (Douglas-fir) plantations. This application had little significant effect on streamwater chemistry (K(+), Na(+), Mg(2+), Ca(2+), Cl(-), NO3(-), NH4(+), PO4(3-), SO4(2-), and SiO2 concentrations, electrical conductivity, and pH) when vegetation cover in a watershed was reduced by 4%, but had significant ($P < 0.05$) effects, which lasted for at least five years, when cover was reduced by 43%. In this case, most parameters increased in value following the application, with K(+) and Mg(2+) concentrations and pH values exhibiting the most prolonged increases and NO3(-) concentrations exhibiting the greatest percentage increases. Sulfate and dissolved SiO2 concentrations decreased following the application. Streamwater chemical fluxes were less significant and no decreases were observed. Forest management induced losses of NO3-N in streamwater during the first five post-treatment years in the study area decreased in the order: herbicide application (approximately 40 kg/ha) > clearcutting and slashburning (approximately 20 kg/ha) > clearcutting (approximately 10 kg/ha). In watersheds similar to those of the study area, herbicide application is likely to have a greater impact on streamwater chemistry, in general, than would clearcutting or clearcutting followed by slashburning. (Author's abstract)
W90-00976

**EFFECTS OF PLACER MINING DISCHARGE ON HEALTH AND FOOD OF ARCTIC GRAYLING.**
Alaska Cooperative Fishery Research Unit, Fairbanks.
J. B. Reynolds, R. C. Simmons, and A. R. Burkholder.
Water Resources Bulletin WARBAQ, Vol. 25, No. 3, p 625-635, June 1989. EPA Project no. 808340-01. 5 fig, 4 tab, 38 ref.

Descriptors: *Water pollution effects, *Placer mining, *Sedimentation, *Mine wastes, *Grayling, *Fishkill, Streams, Alaska.

During the summer of 1982, 1983, and 1985, the effects of placer mining sedimentation were assessed on Arctic grayling, Thymallus arcticus, in the headwaters of Birch Creek, northeast of Fairbanks, Alaska. Differences were compared between two streams (one that was undisturbed and one with mining activity upstream) near the confluences. Studies of caged fish demonstrated that, if grayling could not escape from streams carrying mining sediments, they would either die at high rates (sac fry) or suffer gill damage, starvation, and slowed maturation (age-0 fingerlings and age-2 juveniles). Indirect effects of sedimentation, through loss of summer habitat for feeding and reproduction, may more severely affect grayling population than the direct effects of sedimentation on the health and survival of individual fish. (Author's abstract)
W90-00978

**ACUTE SENSITIVITY OF EARLY LIFE STAGES OF FATHEAD MINNOW (PIMEPHALES PROMELAS) TO ACID AND ALUMINUM.**
Johns Hopkins Univ., Laurel, MD.
R. E. Palmer, R. J. Klauda, M. A. Jepson, and E. S. Perry.
Water Research WATRAG, Vol. 23, No. 8, p 1039-1047, August 1989. 6 fig, 1 tab, 35 ref. DNR Contract PR86-070-02.

Descriptors: *Acid rain effects, *Fathead minnows, *Bioassay, *Aluminum, *Hydrogen ion concentration, Hardness, Life stages, Toxicity, Mortality.

Fathead minnow (Pimephales promelas) 1-d post hatch larvae, 12-d post-hatch larvae, and 4-wk post-hatch juveniles were exposed to combinations of acid and inorganic aluminum (Al) for 96 h in the laboratory. Life stages were exposed, under flow-through conditions, to four nominal pH levels: 4.5, 5.5, 6.5, 7.5 (control) and five nominal Al concentrations: 0 (control), 50, 100, 200, 400 micrograms/L in freshwater with a total hardness of 20-24 mg/L as CaCO3. Theoretical speciation of the measured total dissolved monomeric Al was performed in order to estimate the toxic forms of Al. The ranking of life stage sensitivities to acid alone was 1-d larvae, most sensitive, followed by 12-d larvae and juveniles. At pH 4.5, all three stages exhibited 100% mortality in all Al treatments and controls. At pH 5.5, 90-100% mortality occurred in all but the 50 micrograms/L Al treatment and the no Al control. At that pH, hydroxoid species of Al were the predominate forms of the total dissolved monomeric aluminum. At pH 6.5 and 7.5, Al was not toxic to the 1-d larvae and juveniles, but the mortality of 12-d larvae exposed to Al (predominately hydroxy species) ranged from 18 to 68% with no clear dose response. (Author's abstract)
W90-01004

**MORPHOLOGICAL VARIATION OF ELLIPTIO COMPLANATA (BIVALVIA: UNIONIDAE) IN DIFFERING SEDIMENTS OF SOFT-WATER LAKES EXPOSED TO ACIDIC DEPOSITION.**
University of Western Ontario, London. Dept. of Zoology.
S. G. Hinch, L. J. Kelly, and R. H. Green.
Canadian Journal of Zoology CJZOAG, Vol. 67, No. 8, p 1895-1899, August 1989. 2 fig, 2 tab, 33 ref.

Descriptors: *Clams, *Acidic water, *Acid rain effects, *Water chemistry, *Lake sediments, Elliptio, Shell morphology, Alkalinity, Conductivity, Hydrogen ion concentration, Water depth, Turbulent flow, Correlation analysis, Principal component analysis.

Clam shell morphology was related to lake water chemistry and sediment properties for Elliptio complanata from 40 south central Ontario lakes. Principal component analyses described the major trends in the environment data. Relationships between shell morphology and the environmental trends were ascertained through a canonical correlation analysis. Thicker shells were related to increasing alkalinity, conductivity, and pH, suggesting that shell formation is favored in well-buffered habitats that are not affected by acidic deposition. It was also determined that narrow shells were related to coarse sediment in deeper water. This pattern of variation in shell morphology may be adaptive because streamlined shells would better enable clams to maintain their position in turbulent habitats. The water chemistry and sediment property correlates with shell morphology were inde-

pendent with each other. Any attempt to use unionid shells as long-term indicators of changes in environmental water chemistry must be preceded by consideration of other habitats such as water turbulence, sediment type, and depth. (Author's abstract)
W90-01012

**LETHAL AND SUBLETHAL TOXICITY OF 4-NONYLPHENOL TO THE COMMON MUSSEL (MYTILUS EDULIS L).**
Kristenebergs Marinbiologiska Station, Fiskebackskil (Sweden).
A. Granmo, R. Ekelund, K. Magnusson, and M. Berggren.
Environmental Pollution ENPOEK, Vol. 59, No. 2, p 115-127, 1989. 4 fig, 1 tab, 29 ref. National Environmental Protection Board contract 5312147-1.

Descriptors: *Mytilus, *Phenols, *Toxicity, *Water pollution effects, Fertilization, Nonylphenol, Embryonic growth stage.

The toxicity of nonylphenol to the common mussel (M. edulis) was determined in both semistatic and continuous flow test systems. The LC50 values obtained were for 96 h, 3.0 mg/l; 360 h, 0.5 mg/l; and 850 h, 0.14 mg/l. Sublethal effects, manifested as decreased byssus strength and change of scope for growth, were obtained at a concentration as low as 0.056 mg/l. Fertilization and early developmental success were not affected at the highest concentration tested (0.2 mg/l). (Author's abstract)
W90-01013

**SUBLETHAL EFFECTS OF ZINC AND MUNICIPAL EFFLUENTS ON LARVAE OF THE RED ABALONE HALIOTIS RUFESCENS.**
California Univ., Santa Cruz. Inst. of Marine Sciences.
J. W. Hunt, and B. S. Anderson.
Marine Biology MBIOAJ, Vol. 101, No. 4, p 545-552, Jun 89. 7 fig, 2 tab, 38 ref. California State Water Resources Control Board contract 5-222-250-0.

Descriptors: *Sublethal effects, *Municipal wastewater, *Water pollution effects, *Zinc, *Toxicity, *Abalone, *Pollutant identification, Haliotis, Larvae, Larval growth stage, Dissolved oxygen, Hydrogen ion concentration, Salinity, Temperature.

Experiments were conducted to develop a sensitive sublethal toxicity test protocol to determine the toxicity of municipal wastewater effluents to larvae of the red abalone Haliotis rufescens. In multiple tests, fertilized embryos were exposed for 48 h to dilutions of a reference toxicant, zinc sulfate, and to dilutions of primary-treated and secondary-treated effluents. The resulting veliger larvae were examined microscopically for shell abnormalities. In the longer flow-through experiment, abalone were exposed for the entire larval phase, from the 2-cell stage through metamorphosis, to compare zinc effects on metamorphosis with zinc effects on short-term larval shell development. Dissolved oxygen, pH, salinity and temperature were measured daily in test solutions, and zinc concentrations were verified by chemical analysis. 'No observed concentrations' for zinc were 39 2.1 microgram/l in three 48 h exposures, and 19 microgram/l for the 9-day exposure through metamorphosis. Median effect concentrations were 68 6.9 microgram/l in 48 h tests and 50 microgram/l in the 9-day test. Abalone larva were affected at lower concentrations of primary than of secondary effluent. (Author's abstract)
W90-01039

**UNDERWATER LIGHT CONDITIONS AS A KEY FOR PHYTOPLANKTON PHOTOSYNTHETIC EFFICIENCY I. RIO TERCERO RESERVOIR CORDOBA, ARGENTINA. (CONDICIONES DE LUZ SUBACUATICA COMO FACTORES DETERMINANTES DE LA EFICIENCIA FOTOSINTETICA FITOPLANCTONICA. 25P. I. RIO TERCERO RESERVOIR, CORDOBA, ARGENTINA. EMBALSE DE RIO TERCERO (CORDOBA, ARGENTINA)).**
Consejo Nacional de Investigaciones Cientificas y Tecnicas, Buenos Aires (Argentina). Inst. de Limnologia.
C. Romero, A. A. Mariazzi, and P. Arenas.
Oecologia Aquatica, Vol. 9, p 1-8, December 1988. 2 fig, 4 tab, 29 ref. English summary.

Descriptors: *Limnology, *Water pollution effects, *Eutrophication, *Euphotic zone, *Reservoirs, Rio Tercero Reservoir, Light intensity, Secchi disks, Primary productivity.

The Secchi disc depth, the energy of photosynthetic available radiation (PAR) in the water column, the primary production rate and the concentration of photosynthetic pigments were measured in Rio Tercero reservoir (Argentina). The compensation point, the relative intensities of this point and Secchi disc, the photosynthetically stored radiation, and the respective photosynthetic efficiencies were calculated. The percentage of transmitted light fluctuated according to the amount of suspended particulate material (winter) or the presence of high algal concentration (spring-summer). The euphotic stratum in summer (1.1 m to 3 m) reached 5.5 m in the winter (August). The mean extinction coefficient up to the euphotic stratum was very highly variable. The photosynthetic efficiency was lower than 1 in surface during spring and summer. The values obtained in the euphotic stratum were intermediate. Other significantly high values were found at deeper levels. The relevant fluctuations of all variables including the extinction coefficient, the relative depth and intensity of Secchi disc, the euphotic stratum depth and the compensation point confirm the eutrophic characteristics of the ecosystem. Eutrophication levels of the reservoir are distinct from values of other parameters such as the primary production rate, pigment concentration, photosynthetic efficiencies and the seasonal appearance of algal blooms. (Author's abstract)
W90-01053

**IMPACT OF FLUE-GAS DESULPHURIZATION ON THE WATER ENVIRONMENT.**
Environmental Sciences Ltd., Vancouver (British Columbia).
M. R. G. Taylor, R. Heaton, and R. Baty.
Journal of the Institution of Water and Environmental Management, Vol. 3, No. 3, p 227-234, June 1989. 1 fig, 4 tab, 6 ref.

Descriptors: *Water pollution control, *Air pollution control, *Emission control, *Wastewater treatment, *Water pollution effects, *Electric power production, *Sulfur, *Coal, *Gypsum, *Electric powerplants, Limestone, Mathematical models, Liquid wastes, Process water, Effluents, Pollutants, Environmental engineering, Metals, Fluorides, Nitrates, Environmental effects, Neutralization, Precipitation, Sedimentation, Cooling water, England.

Electricity generation in the U.K. is dominated by fossil fuels, principally coal. In order to reduce emissions of sulfur dioxide to the atmosphere new fossil fuel-fired power stations will be equipped with flue-gas desulfurization (FGD) facilities. The first generation of these plants will be based on the limestone-gypsum process. In addition to the product gypsum, the process generates a liquid effluent which contains contaminants such as metals, fluoride, and nitrate. A mathematical model has been developed to predict effluent volumes and composition as a function of different coal, limestone, and process water combinations. The model also calculates the effect of the discharge of this effluent on a receiving watercourse, both untreated and following treatment based on neutralization and precipitation/sedimentation. Treated FGD effluent has little effect on power station cooling-water discharges, via which the effluent would normally be discharged, for either coastal once-through or inland recirculating cooling systems. (Author's abstract)
W90-01088

**NATURAL ENVIRONMENT SURPASSES POLLUTED ENVIRONMENT IN INDUCING DNA DAMAGE IN FISH.**
Institut Rudjer Boskovic, Zagreb (Yugoslavia). Center for Marine Research.
B. Kurelec, A. Garg, S. Krca, M. Chacko, and R. C. Gupta.
Carcinogenesis CRNGDP, Vol. 10, No. 7, p 1337-1339, July 1989. 1 fig, 1 tab, 28 ref. U.S. EPA cooperative agreement CR813840 and U.S. Public Health Service grant CA30606.

Descriptors: *Water pollution effects, *Environmental effects, *Fish physiology, DNA damage, Genetic studies, Chub, Barbel, Bream, Carp, Mullet.

Measurement of specific DNA adduct concentrations in target tissues of organisms may provide a key biologic end-point of exposure to environmental carcinogens. Using a general and highly sensitive assay with 32P-postlabeling, we found that natural populations of freshwater fish species chub, barbel, bream and carp, as well as a marine fish mugil, revealed the presence of four to nine qualitatively similar adducts irrespective of whether they were caught from unpolluted or polluted waters. No statistically significant differences were observed between the adduct levels of fish from the unpolluted waters and those of fish from the polluted waters. A dominant feature of the fish DNA adducts was a species specificity. The finding that a vast majority of DNA modifications in fish are caused by natural factors rather than man-made chemicals offers a basis for a more realistic view in assessing the genotoxic risks in any aquatic environment. (Author's abstract)
W90-01114

**EVALUATION OF THE TOXIC EFFECTS OF ORGANOTIN-COMPOUNDS ON CARP IN CONNECTION WITH THEIR ACCUMULATION AND ELIMINATION (OTSENKA TOKSICHESKOGO DEISTVIIA NA KARPA OLOVOORGANICHESKIKH SOEDINEMII V SVIAZI C IKH AKKUMULIATSIEI I VYVEDENIEM).**
Moscow State Univ. (USSR).
O. V. Parina, and P. D. Ozina.
Gidrobiologicheskii Zhurnal GBZUAM, Vol. 25, No. 1, p 72-77, 1989. 2 fig, 4 4 tab, 13 ref. English summary.

Descriptors: *Pesticides, *Antifoulants, *Water pollution effects, *Organotins, *Bioaccumulation, *Carp, Tissue analysis, Fish physiology, Metals.

The accumulation of Sn(113)-labelled trialkyl tin chlorides is some tissues and subcellular structures of the carp liver was investigated during short-term (1-15 days) and long-term (45 days) studies. The toxic effects of organotin compounds (TAO) are defined by the speed of their accumulation in the organs, tissues, and subcellular structures; while their removal depends upon the functional-biochemical properties of tissues, the intensity of metabolic processes, and the mitochondrial reactions of the tissues as well as on the physico-chemical characteristics of the compounds used. Predicting the degree of toxicity can be made through a study of this relationship (accumulation-speed). (Peters-PTT)
W90-01144

**IMPACT OF ATMOSPHERIC DEPOSITION ON THE AQUATIC ECOSYSTEM WITH SPECIAL EMPHASIS ON LAKE PRODUCTIVITY, NEWFOUNDLAND, CANADA.**
Areco Canada, Inc., Ottawa (Ontario).
M. Rybak, I. Rybak, and D. A. Scruton.
Hydrobiologia HYDRB8, Vol. 179, No. 1, p 1-16, July 21, 1989. 7 fig, 2 tab, 86 ref. Supply and Services Canada contract FP001-6-2140/01-SC.

Descriptors: *Water pollution sources, *Acid rain effects, *Lake sediments, *Heavy metals, *Canada, Newfoundland, Phosphorus, Magnesium, Calcium, Sodium, Potassium, Iron, Manganese, Chromium, Copper, Zinc, Lead, Cobalt, Mercury, Arsenic, Nickel, Water pollution.

To document and analyze the ecosystem response to acidification and possible concurrent heavy

metal enrichment process, a detailed paleoecological study was conducted in Lake 817, a small, and sensitive, second order lake, in insular Newfoundland. The inferred pH history of the lake was recreated using the region-specific equation relating fossil diatom taxa to pH. The profile demonstrated a fairly stable pH history over the bottom 22 cm of the sediment core with an appreciable pH decline in the upper 5 cm. The decrease of inferred pH began in the 1930's (ca. 1931 to 1944) and the lowest inferred pH value (5.3) was observed in the surface stratum. The decreasing pH trend (0.4 unit; 5.7 to 5.3) between ca. 1931 and 1985 correlated well with changes in sediment chemistry. Major elements (P, Mg, Ca, Na, and K) showed significant decrease in deposition primarily in the upper 3 cm level (ca. 1944). The profiles of selected metals (Fe, Mn, Cr, Cu, Zn, Pb, Co, Hg, As, and Ni) indicated that the deposition of these elements increased noticeably, primarily in the upper 3 cm level. The enrichment of Pb began earlier, about 50 years ago (1931 to 1944). The stratigraphy of fossil pigments (chlorophyll derivatives and total carotenoids) demonstrated a general trend of increasing accumulation upwards in the core while the only significant decrease in pigments was observed in the recent strata (ca. between 19567 to 1985). The most dramatic decrease of primary production occurred during ca. 1957 to 1974 period and this phenomenon was associated with increased levels of heavy metals. It seems that primary production in oligotrophic, acidifying lakes in Newfoundland is controlled more by nutrients loading and the possible toxicological effects of heavy metals, than directly by water acidity. (Author's abstract)
W90-01151

**EFFECTS OF EIGHT TRACE METALS IN ACID SOFT WATER ON SURVIVAL, MINERAL UPTAKE AND SKELETAL CALCIUM DEPOSITION IN YOLK-SAC FRY OF BROWN TROUT, SALMO TRUTTA L.**

Nottingham Univ. (England). Dept. of Zoology.
J. P. Reader, N. C. Everall, M. D. J. Sayer, and R. Morris.
Journal of Fish Biology JFIBA9, Vol. 35, No. 2, p 187-198, August 1989. 3 fig, 2 tab, 43 ref. Natural Environmental Research Council Grant No. GR3/6176.

Descriptors: *Water pollution effects, *Acid rain effects, *Trout, *Aluminum, *Cadmium, *Copper, *Iron, *Manganese, *Nickel, *Lead, *Zinc, Heavy metals, Acidic water, Metabolism, Calcium.

Recently hatched fry of brown trout were exposed to each of eight trace metals (Al, Cd, Cu, Fe, Mn, Ni, Pb, Zn) and to a mixture of all eight, as concentrations typical of soft acid waters, in flowing artificial soft water medium at pH 4.5 and 6.5, for 30 days. At pH 4.5, in the absence of trace metals, net uptake of Ca, Na and K and skeletal calcification were impaired, but mortalities were low (10%). At pH 4.5, in the presence of Al, Cu, Pb and Zn individually and the mixture, mortalities were high (87-100%). Cd, Fe, Mn and Ni at pH 4.5 each caused some mortalities (17-43%) and impaired skeletal calcification. At pH 6.5, each of Al, Cd, Cu, Fe, Mn, Pb and the mixture of metals impaired net Ca uptake and (except Al, Fe and Pb) skeletal calcification. Net K uptake was impaired by Al and by the mixture, and less severely by Cu and by Fe. Net Na uptake was impaired by Al and by the mixture, and less severely by Fe and by Mn. The role of trace metals other than Al in fisheries' decline in soft acid waters is discussed. (Author's abstract)
W90-01165

**DIFFERENTIAL EFFECTS OF LOW PH AND ALUMINIUM ON THE CAUDAL NEUROSECRETORY SYSTEM OF THE BROOK TROUT, SALVELINUM FONTINALIS.**

Quebec Univ., Montreal. Dept. of Biological Sciences.
A. Hontela, Y. Roy, R. van Coillie, K. Lederis, and G. Chevalier.
Journal of Fish Biology JFIBA9, Vol. 35, No. 2, p 265-273, August 1989. 3 fig, 2 tab, 26 ref. NSERC grant no. 9847.

Descriptors: *Trout, *Aluminum, *Water pollution effects, *Acid rain effects, *Acidic water, Water softening, Metabolism.

Brook trout were subjected to soft water at pH 6.5, 5.5 or 5.0 without aluminium added, or to water at pH 5.5 with 200, 300 or 500 microgram Al/l added. The response of the caudal neurosecretory system to low pH or aluminium was evaluated after one week by measuring the urotensin I and urotensin II concentrations in the urophysis by radioimmunoassay, and by morphometric analysis of the caudal neurosecretory cells. A positive correlation was found between urotensin II concentrations and total aluminium in the water. Morphometric indices (cell size and proportion of lobed nuclei in the caudal neurosecretory cells) suggested increased synthetic activity in the caudal neurosecretory cells of fish at pH 5.5, compared to pH 6.5. (Author's abstract)
W90-01166

**HEMOSTATIC DISORDER IN COMMON CARP INDUCED BY EXPOSURE TO THE HERBICIDE MOLINATE.**

Miyazaki Univ. (Japan). Dept. of Fisheries.
H. Kawatsu, K. Kondo, and K. Kubono.
Nippon Suisan Gakkaishi (Bulletin of the Japanese Society of Scientific Fisheries) NSUGAF, Vol. 55, No. 5, p 779-783, May 1989. 2 fig, 2 tab, 12 ref.

Descriptors: *Water pollution effects, *Carp, *Herbicides, Blood disorders, Molinate.

Hemostatic disorders in common carp induced by exposure to the herbicide molinate were investigated. Fish were exposed to molinate at 0.50 ppm for 9 days in Experiment 1, and at 0.32 ppm for 13 days in Experiment 2. Blood was collected from all specimens at various intervals, and activated partial thromboplastin times and prothrombin times were determined. A prothrombin correction test was applied to the fish exposed to molinate, and the effect of menadione dimethylpyrimidinol bisulfite in preventing the prolongation of clotting time was examined. The hemostatic disorders induced by exposing fish to molinate are summarized as follows: (1) Prolongations were observed in both activated partial thromboplastin times and prothrombin times after 6-7 days. Thereafter, the prolongation of prothrombin times became more pronounced than that of activated partial thromboplastin times. (2) The prolongation of prothrombin times was corrected by the addition of stored serum, suggesting that depleted coagulation factors exist in the serum. (3) Menadione was highly effective in preventing the prolongation of clotting times. These facts suggest that the hemostatic disorders resulted from a depletion of vitamin K-dependent factors. (Author's abstract)
W90-01167

**CHRONIC DIARRHEA ASSOCIATED WITH DRINKING UNTREATED WATER.**

Centers for Disease Control, Atlanta, GA.
J. Parsonnet, S. C. Trock, C. A. Bopp, C. J. Wood, and D. G. Addiss.
Annals of Internal Medicine AIMEAS, Vol. 110, No. 12, p 985-991, 1989. 1 fig, 5 tab, 26 ref.

Descriptors: *Illinois, *Water pollution effects, *Human diseases, *Toxicity, Well water, Epidemiology.

The causes and characteristics of an outbreak of chronic diarrhea in 72 patients in rural Henderson County, IL, were determined. Subjects included 72 patients who had onset of chronic diarrheal illness between May and August 1987. Controls included local residents and eating companions who did not exhibit symptoms. A cohort study included 80 truck drivers from a local firm. Nonbloody diarrhea was characterized by extreme frequency, marked urgency, fecal incontinence, and weight loss (mean, 4.5 kg). The median incubation period was 10 days. Nine patients were hospitalized; none died. Diarrhea persisted in 87% of patients after 6 months. Antimicrobial therapy produced no clinical improvement. No bacterial, mycobacterial, viral, or parasitic agents known to be enteropathogenic were detected in stools or implicated water. Mild inflammatory changes were seen in 3 of 5 small bowel biopsies and in 2 of 9 colonic biopsies. Case-control studies implicated a local restaurant ($P = 0.001$) and subsequently the untreated well water served in the restaurant ($P = 0.04$) as the vehicle of transmission. (Author's abstract)
W90-01170

**TOXICOKINETICS AND TOXICODYNAMICS OF PYRETHROID INSECTICIDES IN FISH.**

Environmental Research Lab.-Duluth, MN.
S. P. Bradbury, and J. R. Coats.
Environmental Toxicology and Chemistry ETOCDK, Vol. 8, No. 5, p 373-380, 1989. 2 fig, 2 tab, 49 ref. EPA Office of Exploratory Research Grant No. 810659-01-0.

Descriptors: *Toxicology, *Reviews, *Biotransformation, *Pesticide toxicity, *Insecticides, *Pyrethroids, *Water pollution effects, *Fish, Trout, Toxicokinetics, Toxicodynamics.

The pyrethroid insecticides are extremely toxic to fish, with 96-h LC50 values generally below 10 micrograms per liter and i.p. and i.v. LD50 values below 20 mg per kg. Corresponding LD50 values in mammals and birds are in the range of several hundred to several thousand milligrams per kilogram. This review examines pyrethroid toxicokinetics and toxicodynamics in fish as critical factors associated with species selectivity. Studies with permethrin, cypermethrin and fenvalerate have established that rates of metabolism and elimination in rainbow trout are significantly lower than those reported for birds and mammals. Comparatively low lethal brain pyrethroid concentrations and nonneural aspects of pyrethroid intoxication in fish suggest that variations in toxicodynamics are also crucial in evaluating pyrethroid selectivity. (Author's Abstract)
W90-01175

**TOXICITY OF PYRETHROID INSECTICIDES TO FISH.**

Department of Fisheries and Oceans, St. Andrews (New Brunswick). Biological Station.
K. Haya.
Environmental Toxicology and Chemistry ETOCDK, Vol. 8, No. 5, p 381-391, 1989. 3 fig, 4 tab, 50 ref.

Descriptors: *Biotransformation, *Toxicity, *Water pollution effects, *Pesticide toxicity, *Insecticides, *Pyrethroids, *Fish, Reviews.

A selected review of the biological, chemical and environmental factors that affect the acute and chronic, lethal and sublethal toxicity of pyrethroid insecticides to fish is presented. Pyrethroid insecticides are extremely toxic to fish; for example, 96-h LC50 values are in the nanamole per liter range. The symptoms associated with acute lethality suggest that effects on the nervous system, respiratory surfaces and renal ion regulation are associated with the mechanism of lethal action in fish. Qualitative structure-activity relationships indicate that the structural features required for good insecticidal activity and for lethality to fish are the same. Lethality also varies with biological (species, size) and environmental (temperature, sediment) factors. Some of these effects may be related to bioavailability and rates of pyrethroid biotransformation. Chronic exposure studies indicate that newly hatched larvae or early juveniles are the life stages most sensitive to pyrethroids. Exposures of fish to sublethal concentrations of pyrethroids have resulted in decreased growth and impaired swimming performance. The effects on bioenergetics and energy metabolism are variable. (Author's Abstract)
W90-01176

**TOXICITY OF PYRETHROIDS TO MARINE INVERTEBRATES AND FISH: A LITERATURE REVIEW AND TEST RESULTS WITH SEDIMENT-SORBED CHEMICALS.**

Environmental Protection Agency, Gulf Breeze, FL. Gulf Breeze Environmental Research Lab.
J. A. Clark, L. R. Goodman, P. W. Borthwick, J.

M. Patrick, and G. M. Cripe.
Environmental Toxicology and Chemistry ETOCDK, Vol. 8, No. 5, p 393-401, 1989. 6 tab, 25 ref.

Descriptors: *Pesticide toxicity, *Toxicity, *Insecticides, *Pyrethroids, *Water pollution effects, *Sediments, *Fish, *Aquatic animals, *Reviews, *Crustaceans, Invertebrates, Oysters, Shrimp.

Data on the acute and chronic toxicities of permethrin, fenvalerate, cypermethrin and flucythrinate to marine invertebrates and fish are reviewed. The mysid Mysidopsis bahia consistently is among the most sensitive crustaceans tested, with 96-h LC50's of less than 0.02 micrograms per liter for permethrin and of less than 0.01 micrograms per liter for fenvalerate, cypermethrin and flucythrinate. The potential for chronic toxicity to fish is minimal for permethrin, moderate for fenvalerate and relatively great for flucythrinate. Laboratory toxicity tests were conducted with sediment-source fenvalerate and cypermethrin under static and flow-through conditions to determine the degree of contamination necessary to achieve acute lethal effects on mysids, grass shrimp (Palaemonetes pugio) and pink shrimp (Penaeus duorarum). Mortality was observed in test animals only in systems where the concentrations of sediment-source pyrethroids were sufficient to establish lethal concentrations in the overlying water through sediment/water partitioning. For fenvalerate, effects occurred at nominal sediment concentrations of 0.1 mg/kg for mysids and grass shrimp and at 10 mg/kg for pink shrimp. Normal sediment concentrations of cypermethrin of 0.1 mg/kg or 1.0 milligram per kg resulted in mortality in mysids and grass shrimp, whereas 1.0 milligram per kg was the only test concentration that caused mortality in pink shrimp in the static and flow-through test systems. (Author's Abstract)
W90-01177

**TOXICITY OF SYNTHETIC PYRETHROIDS TO FRESHWATER INVERTEBRATES.**
Environmental Research Lab.-Duluth, MN.
R. L. Anderson.
Environmental Toxicology and Chemistry ETOCDK, Vol. 8, No. 5, p 403-410, 1989. 3 fig, 27 ref.

Descriptors: *Pesticide toxicity, *Insecticides, *Reviews, *Toxicity, *Pyrethroids, *Water pollution effects, *Invertebrates.

The laboratory toxicity data on freshwater target and nontarget invertebrates exposed to pyrethroids are reviewed and the state of the data evaluated. Early in their development, pyrethroids were shown to be highly effective insecticides against mosquitoes, blackflies and chironomids. Acute LC50 values for these target animals were often less than 1 microgram per liter. Acute exposures of nontarget invertebrates showed that some species were as sensitive as the target insects. Longer exposures, up to 28 days, showed that lethal effect concentrations were lowered with increased exposure duration. Unfortunately, the long-exposure tests were limited to few species and a few pyrethroids, so no general commentary on no effect concentrations is possible. Some species were affected at concentrations near the analytical detection limit for pyrethroids. The data reviewed show that temperature, life cycle stage and exposure duration will be critical factors in developing the no effect concentrations that are important in risk assessments for nontarget invertebrates exposed to these insecticides. (Author's Abstract)
W90-01178

**ACUTE, CHRONIC AND SUBLETHAL EFFECTS OF SYNTHETIC PYRETHROIDS ON FRESHWATER ZOOPLANKTON.**
National Water Research Inst., Burlington (Ontario). Rivers Research Branch.
K. E. Day.
Environmental Toxicology and Chemistry ETOCDK, Vol. 8, No. 5, p 411-416, 1989. 2 tab, 39 ref.

Descriptors: *Water pollution effects, *Insecticides, *Pesticide toxicity, *Pyrethroids, *Zooplankton, *Reviews, *Toxicity, Sublethal effects.

A review of the acute, subacute and chronic effects of four synthetic pyrethroids--permethrin, cypermethrin, deltamethrin and fenvalerate--on freshwater zooplankton is presented. Acute toxicities in the laboratory were found to range from 0.12 to 5.0 micrograms per liter for cladocerans and copepods. Lower concentrations of pyrethroids (< or = to 0.01 micrograms per liter) reduced reproduction and rates of filtration of food by daphnids. Similar results were observed in field experiments. Simulation of direct overspray of aquatic ecosystems resulted in subsurface concentrations of pyrethroids greater than the levels known to be toxic in the laboratory (> than 1 microgram per liter). At these concentrations, populations of cladocerans were reduced. At concentrations of 0.05 micrograms per liter or greater, rates of filtration by cladocerans were depressed. Indirect effects on communities included increases in populations of rotifers and green algae (Chlorophyta). Higher levels of contamination (> than 10 micrograms per liter) caused reductions in copepods, rotifers, and ostracods. Levels of pyrethroids of 0.01 micrograms per liter or less were found to have no detectable effects on zooplankton in the field. (Author's Abstract)
W90-01179

**COMPARISON AND EVALUATION OF FIELD AND LABORATORY TOXICITY TESTS WITH FENVALERATE ON AN ESTUARINE CRUSTACEAN.**
South Carolina Univ., Columbia. Dept. of Environmental Health Sciences.
D. S. Baughman, D. W. Moore, and G. I. Scott.
Environmental Toxicology and Chemistry ETOCDK, Vol. 8, No. 5, p 417-429, 1989. 2 fig, 4 tab, 26 ref. South Carolina Sea Grant Consortium Grant No. SD84-30 and SD85-10; EPA Grant No. CR-813138-02-0.

Descriptors: *Water pollution effects, *Pesticide toxicity, *Insecticides, *Fenvalerate, *Crustaceans, *Toxicity, Pyrethroids, Agricultural runoff, Shrimp.

Field and laboratory toxicity tests were conducted on the grass shrimp, Palaemonetes pugio, to evaluate the usefulness of laboratory testing in estimating mortality from fenvalerate exposure associated with agricultural runoff. The study examined an integrated approach for assessing the impacts of fenvalerate on estuarine fauna, using 96-h static-renewal and 6-h pulsed-dose laboratory toxicity tests and in situ toxicity tests. The laboratory toxicity tests with fenvalerate gave 96-h LC50 values ranging from 0.007 to 0.071 micrograms per liter and 6-h PDLC50 values ranging from 0.100 to 0.130 micrograms per liter. Comparisons of the results of the two toxicity tests with laboratory-derived LC50 values showed good agreement between field and laboratory toxicity data. The variation between field and laboratory toxicity tests may have been due to the limitations of the water sampling regime used in characterizing the pesticide exposure during the field toxicity tests. These comparisons suggest that a combination of laboratory and field toxicity testing is required to estimate the actual field mortality from fenvalerate exposure associated with agricultural runoff. Future studies should include composite water sampling and more frequent discrete sampling methods to better characterize field exposure regimes. (Author's Abstract)
W90-01180

**COMPARATIVE ECOLOGICAL AND TOXICOLOGICAL INVESTIGATION OF A SECONDARY WASTEWATER TREATMENT PLANT EFFLUENT AND ITS RECEIVING STREAM.**
Kentucky Univ., Lexington. School of Biological Sciences.
W. J. Birge, J. A. Black, T. M. Short, and A. G. Westerman.
Environmental Toxicology and chemistry ETOCDK, Vol. 8, No. 5, p 437-450, 1989. 1 fig, 9 tab, 34 ref. EPA Cooperative Agreement No. CR-810001-01-1.

Descriptors: *Water pollution effects, *Toxicology, *Water pollution sources, *Wastewater treatment, *Effluents, Contamination, Fish, Macroinvertebrates, Kentucky River.

A comparative ecological and toxicological investigation was conducted on a secondary wastewater plant point-source discharge and the receiving system, a fourth-order freshwater stream in the Kentucky River basin. The principal objectives were to assess downstream persistence of aquatic contaminants, to qualify their effects on structure and function of aquatic communities and to evaluate the 8 day fathead minnow embryo-larval test for measuring instream toxicity and estimating chronic effects on aquatic biota. The principal ecological endpoints included species richness, diversity, density and dominance of macroinvertebrates and diversity of fish species. Marked downstream gradients existed for effluent dilution, decreasing concentration of selected chemicals, improvement in ecological conditions and decreasing toxicity, as measured in on-site-renewal tests. A good predictive correlation was found between embryo-larval survival and independent ecological parameters, especially species richness of macroinvertebrates. In addition, static renewal and flow-through toxicity tests were performed with effluent dilutions to determine LC50 and toxicity threshold values, expressed as percent effluent by volume. The estimated toxicity thresholds correlated closely with the actual percent instream effluent dilution observed at the first downstream station at which no ecological impact was discernible. (Author's Abstract).
W90-01181

**TOXICITY OF NINE BENCHMARK CHEMICALS TO SKELETONEMA COSTATUM, A MARINE DIATOM.**
Dow Chemical U.S.A., Midland, MI. Health and Environmental Sciences.
U. M. Cowgill, D. P. Milazzo, and B. D. Landenberger.
Environmental Toxicology and Chemistry ETOCDK, Vol. 8, No. 5, p 451-455, 1989. 9 tab, 19 ref.

Descriptors: *Water pollution effects, *Diatoms, *Toxicity, *Herbicides, *Phytotoxicity, Estuarine environment, Algae.

The sensitivity of a marine diatom to eight common chemicals and one herbicide was determined. The 50% reduction in the number of cells per milliliter and that of total cell volume multiplied by 10000 cubic micrometers per milliliter was estimated in relation to each of the nine chemicals. Nominal concentrations of triclopyr triethylamine salt, K2Cr2O7, 4-chlorophenol and phenol were slightly toxic (> 10 mg/L) according to the US Environmental Protection Agency classificatory scheme, while diethanolamine, chlorobenzene, chloroform, acetone and ethanol were classified as practically nontoxic (> 100 mg/L). No observed effect levels were found for each of the two cell measurements in relation to each of the chemicals tested for the 5 day period of the test. The range was found to be from 1 to 6000 mg/L for total cell count and from 0.65 to 6000 mg/L for total cell volume. Data on the sensitivities of the other organisms to the group of common chemicals are also included. The marine diatom proved to be less sensitive to K2Cr2O7 and diethanolamine than the green alga Selenastrum capricornutum. (Author's Abstract)
W90-01182

**TOXICITY OF ACETYLENIC ALCOHOLS TO THE FATHEAD MINNOW, PIMEPHALES PROMELAS: NARCOSIS AND PROELECTROPHILE ACTIVATION.**
Environmental Research Lab.-Duluth, MN.
G. D. Veith, R. L. Lipnick, and C. L. Russom.
Xenobiotica XENOBH, Vol. 19, No. 5, p 555-565, 1989. 5 fig, 1 tab, 50 ref.

Descriptors: *Toxicity, *Water pollution effects, *Fathead minnows, *Organic wastes, Organic compounds, Alcohols, Poisons.

The 96-h LC50 values for 16 acetylenic alcohols in the fathead minnow (pimephales promelas) were determined using continuous-flow diluters. The measured LC50 values for seven tertiary propargylic alcohols agreed closely with the quantitative structure-activity relationship (QSAR) model predictions based upon data for other organic nonelectrolytes acting by a narcosis mechanism. Four primary and four secondary propargylic alcohols were 7 to 4600 times more toxic than the respective narcotic toxicity estimated by QSAR. Metabolic activation to electrophilic alpha,beta-unsaturated propargylic aldehydes or ketones is proposed to account for the increased toxicity. 3-Butyn-1-ol and 4-pentyn-2-ol, primary and secondary homopropargylic alcohols, were 320 and 160, respectively, times more toxic than predicted. In this case an activation step involving biotransformation to an allenic electrophile intermediate was proposed. (Author's abstract)
W90-01209

**EFFECT OF CADMIUM ON PROLACTIN CELL ACTIVITY AND PLASMA ELECTROLYTES IN THE FRESHWATER TELEOST OREOCHROMIS MOSSAMBICUS.**
Katholieke Univ. Nijmegen (Netherlands). Dept. of Animal Physiology.
H. Fu, R. A. C. Lock, and S. E. W. Bonga.
Aquatic Toxicology AQTODG, Vol. 14, No. 4, p 295-306, May 1989. 3 fig, 1 tab, 43 ref.

Descriptors: *Water pollution effects, *Hormones, *Fish, *Cadmium, *Toxicology, Prolactin cell activity, Teleosts.

The role of hormones in the acclimation of fish to cadmium (cd) is investigated. Exposure of tilapia to a sublethal cd concentration (10 microg/l) led after 4 days to a rapid and substantial decrease of plasma total Ca and a small drop in plasma osmolarity and Na(+). This ionic disturbance was only transitory and control levels were reached after 14 days. Prolactin is implicated in this recovery since prolactin cell activity increased markedly during the first 14 days. The gradually decreasing activity of prolactin cells thereafter points to induction of a second mechanism sustaining resistance to fish to Cd. In spite of the pronounced hypocalcemia, no apparent signs of demineralization of bony tissues were observed. Since administration of prolactin to tilapia is known to exert a hypercalcemic action by increasing the net branchial Ca(++) uptake, it is concluded that restoration of Cd-induced hypocalcemia is connected with the observed stimulation of prolactin cell activity. (Author's abstract)
W90-01238

**BEHAVIOR OF TADPOLES OF THE BULLFROG, RANA CATESBEIANA, IN RESPONSE TO SUBLETHAL LEAD EXPOSURE.**
Miami Univ., Oxford, OH. Dept. of Zoology.
C. W. Steele, S. Strickler-Shaw, and D. H. Taylor.
Aquatic Toxicology AQTODG, Vol. 14, No. 4, p 331-344, May 1989. 1 fig, 5 tab, 19 ref.

Descriptors: *Water pollution effects, *Amphibians, *Frogs, *Lead, *Lethal limit, *Toxicology, Population exposure, Bullfrogs.

Whether bullfrog, Rana catesbeiana, tadpoles could detect and avoid concentrations of Pb known to affect their behavior is determined and the appropriateness of the EPA-recommended maximum 'safe' concentration of Pb in the water column is examined. Bullfrog tadpoles were exposed to 0 (control), 500, 625, 750 or 1000 microg Pb/l (as lead nitrate) for six days (144 h). Preference/avoidance responses to plumes of Pb-contaminated water and spontaneous locomotor activity were assessed for non-exposed and Pb-exposed tadpoles. No significant differences were seen in preference/avoidance responses to Pb by either non-exposed animals, nor were there significant effects of Pb on spontaneous locomotor activity. There was, however, significantly greater variability in activity of bullfrog tadpoles ($P < 0.025$; folded F-test) exposed to 500, 625, 750 or 1000 microg Pb/l, as compared to control animals. (Author's abstract)
W90-01240

**TOXICITY TESTING USING IMMOBILIZED ALGAE.**
Florida Univ., Gainesville. Dept. of Environmental Engineering Sciences.
For primary bibliographic entry see Field 5A.
W90-01241

**MODIFYING EFFECTS OF LIFE STAGE, IONIC STRENGTH AND POST-EXPOSURE MORTALITY ON LETHALITY OF H(+) AND AL TO LAKE TROUT AND BROOK TROUT.**
Ontario Ministry of the Environment, Dorchester. Dorset Research Center.
N. J. Hutchinson, K. E. Holtze, J. R. Munro, and T. W. Pawson.
Aquatic Toxicology AQTODG, Vol. 15, No. 1, p 1-26, July 1989. 4 fig, 6 tab, 45 ref.

Descriptors: *Acid rain effects, *Water pollution effects, *Lethal limit, *Trout, *Fish, *Hydrogen ion concentration, *Aluminum, Lakes, Brooks, Life stage, Ionic strength.

Lethality of H(+) and Al to egg and fry stages of lake trout (Salvelinus namaycush) and brook trout (S. fontinalis) was determined in a series of laboratory toxicity tests in soft water. Survival of egg and fry stages of lake trout was reduced at pH < 4.8 following exposures of 7-58 days in water containing 4.0 mg/l Ca. Brook trout were more tolerant and survival of eggs and fry was reduced at pH 4.2 and 4.4 with H(+) to produce an omoregulatory failure, and was not observed at pH 5.1-6.0. Lethality of H(+), but not of Al, was increased two-fold in low ionic strength water (Ca = 1.6 mg/l) and addition of NaCl improved fry survival at limiting levels of Ca (0.6 mg/l). Mortality was not confined to the exposure period and often continued after transfer to control water following short-term exposure of eggs and fry. Short-term, single-episode exposures to H(+) and Al suggest that individual snowmelt and rainstorm events should have little impact on salmonid recruitment. Mortality of sac-fry during repeated episodic exposures, superimposed on mortality of cleavage eggs due to chronic acidification is suggested as a possible mechanism of recruitment failure in acidified waters. Survival of lake trout and brook trout populations cannot be ensured in low ionic-strength waters (Ca < 1.6 mg/l) acidified to pH < 5.1, based on their responses to H(+) and Al. (Author's abstract)
W90-01242

**ACUTE TOXICITY, UPTAKE, DEPURATION AND TISSUE DISTRIBUTION OF TRI-N-BUTYLTIN IN RAINBOW TROUT, SALMO GAIRDNERI.**
Waterloo Univ. (Ontario). Dept. of Biology.
For primary bibliographic entry see Field 5B.
W90-01244

**LABORATORY STUDY OF THE EFFECTS OF WATERBORNE CADMIUM, CALCIUM, AND CARBONATE CONCENTRATIONS ON CADMIUM CONCENTRATIONS IN HYALLELA AZTECA (CRUSTACEA: AMPHIPODA).**
Guelph Univ. (Ontario). Dept. of Zoology.
M. Stephenson, and G. L. Mackie.
Aquatic Toxicology AQTODG, Vol. 15, No. 1, p 53-62, July 1989. 5 fig, 3 tab, 21 ref. NSERC strategic grant no. G0918.

Descriptors: *Water pollution effects, *Path of pollutants, *Bioaccumulation, *Cadmium, *Calcium, *Carbonates, *Crustaceans, Factorial experiments, Laboratory methods.

Factorial experiments are reported in which Cd, Ca and carbonate concentrations are independently manipulated in order to separate their effects on Cd accumulation by the amphipod, Hyalella azteca. Cadmium concentrations were measured in H. azteca after 10 days of exposure to experimentally manipulated (factorial design) calcium, cadmium and carbonate concentrations in solution. Two experiments were conducted. The first used 3 calcium (2.5, 4.5, 6.5 mg Cd/l) and 3 carbonate (0.00, 0.05, 0.10 meq/l) concentrations, with 100 ng Cd/l in solution. Cadmium concentrations in H. azteca increased significantly (from 1.63 to 2.19 microg Cd/g dry mass) with decreasing calcium concentrations in solution, but were not affected by carbonate concentrations. The second experiment used 3 concentrations of calcium (2.5, 4.5, 6.5 mg Ca/l), cadmium (10, 50, 250 mg Cd/l) and carbonate (0.00, 0.25, 0.100 meq/l). Cadmium concentrations in H. azteca increased significantly (from 1.45 to 3.04 microg Cd/g dry mass) with increasing cadmium concentrations, and decreasing calcium concentrations (from 1.50 to 2.37 microg Cd/g dry mass), but were not affected by carbonate concentrations. It was concluded that cadmium concentrations in H. azteca are a function of environmental cadmium and calcium concentrations, but are not affected by environmental pH (range 6.8-5.6) or carbonate concentrations. (Author's abstract)
W90-01245

**CARCINOGENIC EFFECTS OF 7,12-DIMETHYLBENZ(A)ANTHRACENE ON THE GUPPY (POECILIA RETICULATA).**
Gulf Coast Research Lab., Ocean Springs, MS.
W. E. Hawkins, W. W. Walker, J. S. Lytle, T. F. Lytle, and R. M. Overstreet.
Aquatic Toxicology AQTODG, Vol. 15, No. 1, p 63-82, July 1989. 20 fig, 4 tab, 22 ref.

Descriptors: *Water pollution effects, *Fish, *Guppies, *Carcinogens.

The carcinogenic effects of 7,12-dimethylbenz(a)anthracene (DMBA) on the king cobra strain of guppy (Poecilia reticulata) were examined. Specimens were exposed for 6 h once weekly for 4 wk to DMBA. Guppies were 6-11 days old at the initial exposure. Treatment groups included the following: (1) untreated control, (2) dimethylformamide (DMF) carrier control, (3) low, water-mediated DMBA concentration (about 1-3 microg/l or ppb DMBA, (4) intermediate, DMF-mediated DMBA concentration (about 20 ppb DMBA), and (5) high, DMF-mediated DMBA concentration (About 35 ppb DMBA). Hepatic neoplasms developed in guppies exposed to the intermediate and high concentrations. Both of these exposure media contained the same concentrations of soluble DMBA. The high exposure medium, however, also contained an insoluble, particulate fraction of DMBA. Hepatic neoplasm incidences in fish exposed to the intermediate concentrations were 10% at 24 wk and 19% at 37 wk after the initial exposure. In samples from the high concentration group, 47% had hepatic neoplasms at 24 wk and 46% at 37 wk. Histologically, the hepatic lesions were categorized as altered foci, hepatocellular adenomas, and hepatocellular carcinomas. In addition to liver neoplasms, several other types of lesions developed in DMBA-exposed guppies. These included two undifferentiated sarcomas, a rhabdomyosarcoma, a renal adenocarcinoma, and a neurilemmoma. Only one control specimen (representing 0.38% of all controls) had a neoplastic lesion, a small hepatocellular adenoma in a 37 wk specimen. It is demonstrated that the guppy develops hepatic and extrahepatic neoplasms rapidly following brief water-borne exposures to those rather low levels of DMBA. Furthermore, it is shown that the particulate fraction of DMBA contributes to the carcinogenicity of the compound. (Author's abstract)
W90-01246

**QSAR STUDY OF THE TOXICITY OF NITROBENZENE DERIVATIVES TOWARDS DAPHNIA MAGNA, CHLORELLA PYRENOIDOSA AND PHOTOBACTERIUM PHOSPHOREUM.**
Utrecht Rijksuniversiteit (Netherlands). Dept. of Veterinary Pharmacology, Pharmacy and Toxicology.
J. W. Deneer, C. J. vanLeeuwen, W. Seinen, J. L. Maas-Diepeveen, and J. L. M. Hermens.
Aquatic Toxicology AQTODG, Vol. 15, No. 1, p 83-98, July 1989. 1 fig, 8 tab, 44 ref.

Descriptors: *Water pollution effects, *Daphnia, *Toxicity, *Benzenes, *Hydrocarbons, Photobacterium, Chlorella, Quantitative structure-activity relationships, Nitrobenzene.

The toxicity of various mono and dinitrobenzene derivatives towards Daphnia magna, Chlorella pyrenoidosa and Photobacterium phosphoreum is investigated, establishing quantitative structure-activity relationships (QSARs). For the mono-nitro compounds tested, it is observed that their acute and semi-chronic toxicity towards D. magna is only slightly, if at all, higher than the minimum toxicity expected on the basis of anarcosis type of action. Moreover, the logarithm of the octanol/water partition coefficient (log P) is found to be a sufficient descriptor of the toxicity of these compounds to D. magna. The statistical quality of the QSAR describing the toxicity of mono-nitro compounds to C. pyrenoidosa is found to be improved by incorporation of Hammett sigma constants and log P as parameters. For the dinitrobenzene derivatives, it is established that the description of their toxicity to D. magna and C. pyrenoidosa necessitates the use of sigma constants. Furthermore, the toxicity of several of these compounds is found to be more dependent upon the duration of the test than observed for the mono-nitro compounds. This is assumed to be due to the formation of reactive metabolites, which probably contribute substantially to the toxicity of most di-nitro compounds. For the toxicity of dinitrobenzenes to Ph. phosporeum, no significant QSAR could be established employing sigma constants and log P as parameters. THe applicability of the Microtox test as a prescreening tool for the selection of compounds needing further evaluation is discussed. It is concluded that the usefulness of the test is only limited. There appears to be no obvious relationship between the susceptibilites of Ph. phosphoreum and other species to chemicals that cause toxic effects through modes of biological action different from general anaesthesia. (Author's abstract)
W90-01247

**POLYCHLORINATED BIPHENYL (PCB)-CONTAMINATED FISH INDUCES VITAMIN A AND THYROID HORMONE DEFICIENCY IN THE COMMON SEAL (PHOCA VITULINA).**
Agricultural Univ., Wageningen (Netherlands). Dept. of Toxicology.
A. Brouwer, P. J. H. Reijnders, and J. H. Koeman.
Aquatic Toxicology AQTODG, Vol. 15, No. 1, p 99-106, July 1989. 2 fig, 26 ref.

Descriptors: *Water pollution effects, *Polychlorinated biphenyls, *Fish, *Seals, *Vitamins, *Thyroid hormone deficiency, Hormones.

The effect of polychlorinated biphenyl (PCB)-contaminated fish on plasma retinol (vitamin A) and thyroid concentrations, i.e. sensitive indicators of PCB-intoxication, were investigated in the common seal Phoca vitulina. Seals fed fish from Wadden Sea (high-level PCB contamination) had significantly lower concentrations of plasma retinol, total (TT4) and free thyroxin (FT4) and triiodothryronin (TT3) as compared to seals fed fish from the north-east Atlantic (low-level PCB contamination). The PCB-induced reduction in plasma retinol levels disappeared when seals on a Wadden Sea fish diet were subsequently fed Atlantic Ocean fish. It is suggested that reduced plasma retinol and thyroid hormone levels, which may result in an increased susceptibility to microbial infections, reproductive disorders and other pathological alterations, are critically involved in the recently reproductive disorders and the lethal viral infections in seals and other marine mammal populations in the Baltic, North Sea and Wadden Sea. (Author's abstract)
W90-01248

**SIDE-EFFECTS OF PESTICIDES ON GROUND-DWELLING PREDATORY ARTHROPODS IN ARABLE ECOSYSTEMS.**
Agricultural Univ., Wageningen (Netherlands). Dept. of Toxicology.
J. W. Everts, B. Aukema, R. Hengeveld, and J. H. Koeman.
Environmental Pollution ENPOEK, VOl. 59, No. 3, p 203-225, 1989. 9 fig, 8 tab, 33 ref.

Descriptors: *Water pollution effects, *Path of pollutants, *Pesticides, *Arthropods, *Ecosystems, The Netherlands, Fauna.

The effects of above ground applications of pesticides in field crops on the epigeal predator fauna in the Lake Yssel polders in the Netherlands was assessed during a 20-month period by means of pitfall trapping in 17 commercially farmed fields and in one experimental field. The pesticides used during this period were the herbicides 2,4-d-amine and MCPA/MCPP and the insecticides deltamethrin, fenitrothion, and bromophos-ethyl. Deposition of the spray on the soil was determined. Bioassays were carried out in the fields in two cases. Of the taxa identified (staphylinids, carabids and spiders), the erigonid and linyphiid spiders appeared to be sensitive to the three insecticides. Long-term effects, however, could not be demonstrated. No effect was observed from the herbicide applications. Fields which were mechanically treated against weeds had a lower species diversity than chemically treated fields. Ploughing had a detrimental effect on the spiders. The effect of deltamethrin appeared to depend on weather conditions. At higher temperatures, the effect was stronger than at lower temperatures, and no effects could be observed under rainy conditions. A guild of five species (Erigone atra, E. dentipalpis, Oedothorax apicatus, Meioneta rurestris and Bathyphantes gracilis) is recommended as an indicator for early detection of side-effects of insecticides on the epigeal predator fauna. (Author's abstract)
W90-01256

**COMPARISONS OF SINGLE-SPECIES, MICROCOSM AND FIELD RESPONSES TO A COMPLEX EFFLUENT.**
Virginia Polytechnic Inst. and State Univ., Blacksburg. Center for Environmental and Hazardous Material Studies.
K. W. Pontasch, B. R. Niederlehner, and J. Cairns.
Environmental Toxicology and Chemistry ETOCDK, Vol. 8, No. 6, p 521-532, 1989. 1 fig, 6 tab, 32 ref.

Descriptors: *Water pollution effects, *Effluents, *Toxicity, Comparison studies, Ecosystems, Microcosms.

Short-term, single-species toxicity tests are used to identify, regulate and monitor the discharge of problem effluents into receiving ecosystems. The ability of single-species to protect entire ecosystems has been questioned, and microcosm tests have been proposed as additional tools for reducing uncertainty in environmental risk assessment. Responses to complex effluent in microcosms of indigenous macroinvertebrates and protozoans were compared with responses observed in acute tests with Daphnia magna, Ceriodaphnia dubia and Pimephales promelas and in chronic survival and reproductive tests with C. dubia. The predictive utility of these various tests was then evaluated in relation to observed effects in the receiving stream. The acute LC50s (percent effluent) form the acute tests were 63.1 for P. promelas, 18.8 to 31.3 for D. magna and 54.7 for C. dubia. Results from 7-d chronic tests indicated that C. dubia survival was significantly ($P < or = 0.05$) affected at 30% effluent and that reproduction was affected at concentrations > or = 3% effluent. In the protozoan microcosms, community composition was significantly ($P < or = 0.05$) changed at 1.0%, while protozoan species richness was significantly reduced at 3% effluent. In the macroinvertebrate microcosms, mayflies were the only macroinvertebrates adversely affected by the effluent. Four mayfly taxa showed significant ($p < or = 0.05$) reductions in density in the 1.0% treatment and four others were significantly reduced at 10.0%; however, some chironomids had significant increases in density at 0.1% and above. Microcosm responses corresponded well with observed effects in the field. The microcosms correctly predicted which indigenous organisms would be lost and which would be stimulated at various ambient concentrations of the effluent. (Author's abstract)
W90-01261

**DEVELOPMENT AND EVALUATION OF A NOVEL MARINE SEDIMENT PORE WATER TOXICITY TEST WITH THE POLYCHAETE DINOPHILUS GYROCILIATUS.**
Battelle Ocean Sciences, Duxbury, MA.
R. S. Carr, J. W. Williams, and C. T. B. Fragata.
Environmental Toxicology and Chemistry ETOCDK, Vol. 8, No. 6, p 533-543, 1989. 3 fig, 6 tab, 10 ref.

Descriptors: *Water pollution effects, *Sediments, *Marine sediments, *Toxicity, *Polychaetes, Test procedures, Interstitial water.

As a candidate for future use in the National Status and Trends Program, a novel marine sediment pore water toxicity test procedure was developed and evaluated. The test procedure involves obtaining sediment pore water with a pressurized squeeze-extraction device, and then conducting a life-cycle toxicity test with the polychaete Dinophilus gyrociliatus. Recent studies have demonstrated that for certain on polar organic contaminants, the key route of exposure is from the interstitial (pore) water. Sediment samples were collected from 15 different stations in the San Francisco Bay area with varying amounts of contamination. The results show that the life-cycle toxicity test with D. gyrociliatus exposed to pore water samples is sensitive enough to detect differences in the toxicity of moderately contaminated (containing significantly elevated levels of certain pollutants as compared with a clean reference site) sediment. Although no mortality attributable to pore water contamination was observed, a statistically significant reduction in fecundity was observed between the reference site in Tomales Bay and one of the more heavily contaminated sites, Yerba Buena. The results of the fresh versus frozen/thawed comparison indicate that the freezing of samples does not affect their toxicity. The primary advantages of the pore water approach for sediment toxicity testing are that: (1) potential artifacts due to grain size, water quality parameters, or the physical properties of the sediments are eliminated, (2) as preliminary studies suggest, pore water samples can be stored indefinitely before they are used, which greatly simplifies the logistics of testing, and (3) the use of pore water samples allows for a dilution series to be tested, if necessary, thereby allowing an LC50 or EC50 value to be calculated. (Miller-PTT)
W90-01262

**COMPARATIVE ACUTE TOXICITY OF DIETHYLENEGLYCOL DINITRATE TO FRESHWATER AQUATIC ORGANISMS.**
Johns Hopkins Univ., Laurel, MD. Applied Physics Lab.
D. J. Fisher, D. T. Burton, and R. L. Paulson.
Environmental Toxicology and Chemistry ETOCDK, Vol. 8, No. 6, p 545-550, 1989. 2 fig, 4 tab, 16 ref.

Descriptors: *Explosives wastes, *Daphnia, *Water pollution effects, *Rivers, *Toxicity, *Comparison studies, *Aquatic life, *Fish, Catfish, Minnow, Trout.

The acute toxicity of diethyleneglycol dinitrate (DEGDN) to nine freshwater aquatic organisms was determined. Juvenile fathead minnow, bluegill, channel catfish and rainbow trout were exposed to the compound for 96 h. The invertebrates tested for 48 h included the neonate water flea, early-young amphipod, midge larva and the mayfly larva. The effect of DEGDN on the growth of the green alga Selenastrum capricornutum was also studied. The toxicity of DEGDN was relatively low to the nine freshwater species tested. Toxicity values ranged from a 5-d EC50 (standing crop) of less than 58.4 mg/L for the alga to a 96-h LC50 of 491.4 mg/L for the fathead minnow. The most sensitive invertebrate, the daphnid, was more sensitive than the most sensitive fish, the bluegill. (Author's abstract)
W90-01263

**IMMUNOMODULATION IN C57BL/6 MICE FOLLOWING CONSUMPTION OF HALOGE-**

**NATED AROMATIC HYDROCARBON-CONTAMINATED COHO SALMON (ONCORHYNCUS KISUTCH) FROM LAKE ONTARIO.**
McMaster Univ., Hamilton (Ontario). Dept. of Pathology.
G. B. Cleland, P. J. McElroy, and R. A. Sonstegard.
Journal of Toxicology and Environmental Health JTEHD6, Vol. 27, No. 4, p 477-486, 1989. 4 tab, 20 ref.

Descriptors: *Water pollution effects, *Toxicity, *Bioaccumulation, *Salmon, *Hydrocarbons, *Polychlorinated biphenyls, In vivo testing, Immune system, Lake Ontario.

Studies were conducted to assess the immunomodulatory effects associated with the consumption of coho salmon containing halogenated aromatic hydrocarbons and other compounds naturally bioaccumulated from Lake Ontario. Diets containing 33% coho salmon from Lake Ontario or the Pacific Ocean were fed to juvenile C57Bl/6 mice for 2-4 months. After two months, the mice fed Lake Ontario salmon had reduced immunoglobulin M (IgM), IgG, and IgA plaque-forming cell responses to sheep erythrocytes. No changes were observed in total numbers of spleen lymphocytes, total T-lymphocytes or T-lymphocyte subsets as determined by flow cytometry. Cellular immunity, assessed by the cytotoxic T-lymphocyte response to allogeneic tumor target cells, was not altered following dietary exposure to Lake Ontario coho salmon for 4 months. The observed humoral immunomodulation correlated with elevated polychlorinated biphenyl levels in the Lake Ontario salmon diets. The levels of pollutants such as mercury, tin compounds and other metals, PCDDs and PCDFs were not examined. (Author's abstract)
W90-01272

**BENTHIC ALGAL RESPONSES TO N AND P ENRICHMENT ALONG A PH GRADIENT.**
Michigan Univ., Pellston. Biological Station.
For primary bibliographic entry see Field 2H.
W90-01277

**IMPACT OF REPEATED INSECTICIDAL TREATMENTS ON DRIFT AND BENTHOS OF A HEADWATER STREAM.**
Georgia Univ., Athens. Dept. of Entomology.
J. B. Wallace, G. J. Lugthart, T. F. Cuffney, and G. A. Schurr.
Hydrobiologia HYDRB8, Vol. 179, No. 2, p 135-147, July 24, 1989. 3 fig, 5 tab, 27 ref. NSF grant BSR83-16082 and BSR87-18005.

Descriptors: *Water pollution effects, *Fate of pollutants, *Insecticides, *Benthos, *Streams, Headwater streams, Drift, Methoxychlor.

A small first-order, Appalachian Mountain stream received successive seasonal treatments with an insecticide, methoxychlor. Despite an application rate of 10 mg/l methoxyochlor for 4 hours, based on stream discharge, only a small fraction (1.6%) of the insecticide was exported to downstream reaches for a 31 hour period during and following treatment. Most of the insecticide was incorporated into sediments of the streambed, which had residues ranging from 0.038 to 11.7 microg methoxychlor/g dry wt of sediments in June 1986 following treatments in December 1985 and March 1986. Despite low concentrations of methoxychlor measured in stream water (maximum = 128 microg/l) during the initial treatment, massive drift ( > 950,000 organisms and 70 g AFDM biomass) occurred from a stream area of about 144 sq m. Numerically, collector-gatherer taxa (primarily Chironomodae) dominated drift (63%) followed by shredders and predators; however, biomass of drift was dominated by shredders (48.9%), followed by predators and collector-gatherers. Compared with pre-treatment benthic abundances, insects were reduced by 75% following the initial treatment in December 1985, and 85% following an additional treatment in March 1986. Benthic abundances of non-insect taxa showed no significant changes. Benthic abundances of shredder, collector-filterer, and scraper functional groups exhibited significant decreases in the first month following treatment. Although benthic abundances of collector-gatherer and predator taxa were reduced by 48.6 and 40.5, respectively, the reduction was not statistically significant because of the high sample variance. Comparisons of drift composition during the initial treatment with successive quarterly treatments (March 1986 to January 1988) reflected of ongoing pesticide disturbance of the biota as the community structure shifted from one consisting of a diverse insect and non-insect fauna toward one dominated by copepods, oligochaetes, Collembola, and chironomids. (Author's abstract)
W90-01278

**CARBON-CONTROLLED NITROGEN CYCLING IN A MARINE 'MACROCOSM': AN ECOSYSTEM-SCALE MODEL FOR MANAGING CULTURAL EUTROPHICATION.**
Hawaii Inst. of Marine Biology, Honolulu.
For primary bibliographic entry see Field 2L.
W90-01287

**STRUCTURE AND FUNCTION IN A MODEL COASTAL ECOSYSTEM: SILICON, THE BENTHOS AND EUTROPHICATION.**
Rhode Island Univ., Narragansett. Marine Ecosystems Research Lab.
For primary bibliographic entry see Field 2L.
W90-01289

**LIMITING NUTRIENTS OF ALGAL GROWTH IN USHIKU MARSH, (IN JAPANESE).**
National Inst. for Environmental Studies, Tsukuba (Japan). Water and Soil Environment Div.
O. Yagi, N. Ohkubo, N. Tomioka, and M. Okada.
Japanese Journal of Limnology RIZAAU, Vol. 50, No. 2, p 139-148, April 1989. 6 fig, 3 tab, 15 ref. English summary.

Descriptors: *Water pollution effects, *Eutrophication, *Limnology, *Marshes, *Nutrients, *Limiting nutrients, *Japan, *Algal growth, Water quality, Rivers, Lake Kasumigaura, Ushiku Marsh, Japan.

Determination of water quality, Algal Growth Potential (AGP) and limiting nutrients in Ushiku Marsh and related rivers (Inari, Higashiyata and Nishiyata) were carried out using Microcystis flos-aquae, M. aeruginosa and Selenastrum capricornutum in order to clarify the difference between Ushiku Marsh where water bloom occurs very rarely and Lake Kasumingaura where high density water blooms occur every year. T-P concentration of Ushiku Marsh was the same level as in Lake Kasumingaura, However, T-N content in Ushiku Marsh was the same level as in Lake Kasumingaura. AGPs of the filtered samples in Ushiku Marsh were significantly higher than those of the autoclaved samples. Autoclaving was done at 121 C for 15 min. The limiting nutrients in Ushiku Marsh and related rivers were P and EDTA throughout the year for M. flos-aquae, and for M. aeruginosa in the summer season only. Lake Kasumingaura contained more chelated compounds which were growth-stimulating than Ushiku Marsh. This may be one of important reasons why the water bloom does not occur in Ushiku Marsh. (Author's abstract)
W90-01297

**C:N:P RATIO OF MICROCYSTIS AND ANABAENA (BLUE-GREEN ALGAE) AND ITS IMPORTANCE FOR NUTRIENT REGENENERATION BY AEROBIC DECOMPOSITION.**
Kyoto Univ., Otsu (Japan). Otsu Hydrobiological Station.
Y. Tezuka.
Japanese Journal of Limnology RIZAAU, Vol. 50, No. 2, p 149-155, April 1989. 6 fig, 17 ref.

Descriptors: *Limnology, *Decomposing organic matter, *Eutrophication, *Algae, *Cyanophyta, *Carbon, *Nitrogen, *Phosphorus, *Nutrients, *Decomposition, Phytoplankton, Dissolved inorganic nitrogen, Dissolved inorganic phosphorous.

Microcystis and Anabaena were collected from their natural environments and decomposed under aerobic conditions in the laboratory. They had low C : N : P ratios (74 : 13 : 1 for Microcystis and 58 : 8 : 1 for Anabaena by weight) and released both dissolved inorganic nitrogen (DIN) and phosphorous (DIP). It was demonstrated that phytoplankton with low C : N : P ratio release both DIN and DIP by decomposition, whereas those with high C : N : P ratio (200 : 20 : 1 in summer), like the phytoplankton in the eutrophic zone of Lake Biwa during the stagnation period release only DIN. (Author's abstract)
W90-01298

**EPILITHIC ALGAL COMMUNITIES FROM RIVER SEGURA BASIN, SOUTHEASTERN SPAIN.**
Murcia Univ. (Spain). Dept. de Biologia Vegetal.
For primary bibliographic entry see Field 2H.
W90-01304

**ROLE OF BOTTOM SEDIMENTS IN SUSTAINING PLANKTON PRODUCTION IN A LAKE ECOSYSTEM: EXPERIMENTAL DEMONSTRATION USING ENCLOSED WATER BODIES IN A SHALLOW EUTROPHIC LAKE.**
Nagoya Univ. (Japan). Water Research Inst.
For primary bibliographic entry see Field 2H.
W90-01313

**PRODUCTION ECOLOGY OF PHYTO- AND ZOOPLANKTON IN A EUTROPHIC POND DOMINATED BY CHAOBORUS FLAVICANS (DIPTERA: CHAOBOLIDAE).**
National Inst. for Environmental Studies, Tsukuba (Japan). Environmental Biology Div.
For primary bibliographic entry see Field 2H.
W90-01314

**DECOMPOSITION OF LEAF LITTER EXPOSED TO SIMULATED ACID RAIN IN A BUFFERED LOTIC SYSTEM.**
Calgary Univ. (Alberta). Aquatic Ecology Section.
A. Garden, and R. W. Davies.
Freshwater Biology FWBLAB, Vol. 22, No. 1, p 33-44, August 1989. 8 fig, 1 tab, 43 ref.

Descriptors: *Acid rain effects, *Riparian vegetation, *Leaves, *Litter, *Decomposition, *Lotic environment, Nitrogen, Phosphorus, Hydrogen ion concentration, Seasonal variation.

Exposure to simulated acid rain resulted in changes in the chemical content of riparian vegetation and terrestrial leaf litter and had significant effects on leaf litter decay rates in a well-buffered lotic ecosystem. Foliar nitrogen and phosphorus decreased with decreasing pH of the simulated acid rain and microbial activity was greater on leaf litter exposed to rain of pH 5.4 than on leaf litter exposed to pH 3.0 or pH 4.0. Detritivore numbers and biomass were significantly higher on leaf litter exposed to pH 5.4, probably due to the greater palatability of the leaf substrate. Decay rates of leaf litter processed in the summer months were significantly lower than decay rates of litter processed during the autumn/winter due to reduction in nitrogen content and microbial respiration. (Author's abstract)
W90-01316

**LOSS OF SUBMERGED PLANTS WITH EUTROPHICATION: I. EXPERIMENTAL DESIGN, WATER CHEMISTRY, AQUATIC PLANT AND PHYTOPLANKTON BIOMASS IN EXPERIMENTS CARRIED OUT IN PONDS IN THE NORFOLK BROADLAND.**
University of East Anglia, Norwich (England). School of Environmental Sciences.
H. Balls, B. Moss, and K. Irvine.
Freshwater Biology FWBLAB, Vol. 22, No. 1, p 71-87, August 1989. 5 fig, 10 tab, 38 ref.

Descriptors: *Eutrophic lakes, *Eutrophication, *Submerged plants, *Limnology, *Water pollution effects, *Phytoplankton, *Ponds, Nutrients, Phosphorus, Phosphates, Ammonium, Nitrates, Chloro-

phyll a, Fish, Daphnia, Norfolk Broadland, United Kingdom.

During eutrophication of shallow lakes, communities of submerged plants are often replaced by dense phytoplankton populations, but the mechanism by which this occurs is obscure though often assumed to involve shading. This paper introduces a series investigating this change and describes a system of experimental ponds which were variously fertilized with N and P, had fish added or removed, and had their submerged aquatic plants cleared or left intact. Fertilization with phosphate and ammonium nitrate in quantities effectively greater than those in a series of lakes in the adjacent Norfolk Broads, which have lost their submerged plants, did not displace the plant populations. Total P and soluble reactive P concentrations in the water did not increase much with increasing loading in the presence of submerged plants but did so if the plants were manually cleared. Ammonium and nitrate concentrations were kept low, despite large additions in both plant dominated and manually cleared ponds. In the absence of fish there were modest increases in chlorophyll a concentrations with P loading in the presence or absence of submerged plants. The concentrations achieved, however, were much lower than anticipated, probably because of grazing by large-bodied Cladocera. Ponds dominated by plants continued to have low phytoplankton populations even when fish were stocked. Low fish survival in these ponds permitted grazing zooplankters to flourish. In ponds cleared of plants, however, there were significant relationships between chlorophyll a concentration with Daphnia biomass (inverse) and log stock of potentially zooplanktivorous fish (positive). There was a significant relationship between chlorophyll a and total P concentrations in the plant and cleared ponds in 1982 but only in the plant ponds in 183. In all cases the phytoplankton communities were dominated by small, often flagellated, organisms. (See W90-01321 thru W90-01322) (Author's abstract)
W90-01320

**LOSS OF SUBMERGED PLANTS WITH EUTROPHICATION: II. RELATIONSHIPS BETWEEN FISH AND ZOOPLANKTON IN A SET OF EXPERIMENTAL PONDS, AND CONCLUSIONS.**
University of East Anglia, Norwich (England). School of Environmental Sciences.
K. Irvine, B. Moss, and H. Balls.
Freshwater Biology FWBLAB, Vol. 22, No. 1, p 89-107, August 1989. 11 fig, 4 tab, 55 ref.

Descriptors: *Water pollution effects, *Limnology, *Eutrophic lakes, *Eutrophication, *Submerged plants, *Zooplankton, *Fish, *Ponds, Nutrients, Phosphorus, Phosphates, Ammonium, Nitrates, Chlorophyll a, Daphnia, Norfolk Broadland, United Kingdom.

In 1982 and 1983 sets of experimental ponds were left with their submerged plant communities intact (plant ponds) or were cleared manually of them (cleared ponds). The ponds were all fertilized with ammonium nitrate and with variable amounts of phosphate. In 1982 fish were removed from the ponds. Zooplankton communities were dominated by large Cladocera with Daphnia prominent in the cleared ponds and Simocephalus in the plant ponds. There was no detectable effect of differential phpsphorus additions on zooplankton communities or populations. In 1983 zooplanktivorous fish (mainly roach) were stocked in the ponds. In the plant ponds the fish did not survive, probably through severe deoxygenation, and the zooplankton community again included large-bodied Simocephalus. Fish survival was variable in the cleared ponds. Where fish stocks were absent or low (0.5-1 g/sq m) a Daphnia-dominated community persisted; at intermediate fish stocks (18.1 g/sq m) Eudiaptomus gracilis was predominant and where fish stock was high (22.8-29.1 g/sq m) Bosmina longirostris and cyclopoid copepods dominated the communities. Mean biomass of the zooplankton community declined with increase in fish stock to between 5.1 and 18.1 g/sq m and then increased. On the basis of results from experimental ponds and elsewhere, a new hypothesis is presented to account for the switch from aquatic plant to phytoplankton dominance in eutrophicated shallow lakes. It envisages dominance by either group to be possible as alternative states over a wide range of high nutrient loadings. It suggests that each state is buffered against increased loading by mechanisms involving plant and algal physiology and zooplankton grazer populations. The nature of the buffers and the reasons by which one state may be switched to the other are discussed. (See also W90-01320 and W90-01322) (Author's abstract)
W90-01321

**LOSS OF SUBMERGED PLANTS WITH EUTROPHICATION: III. POTENTIAL ROLE OF ORGANOCHLORINE PESTICIDES: A PALAEOECOLOGICAL STUDY.**
University of East Anglia, Norwich (England). School of Environmental Sciences.
J. Stansfield, B. Moss, and K. Irvine.
Freshwater Biology FWBLAB, Vol. 22, No. 1, p 109-132, August 1989. 13 fig, 1 tab, 63 ref.

Descriptors: *Eutrophic lakes, *Eutrophication, *Submerged plants, *Limnology, *Zooplankton, *Phytoplankton, *Chlorinated hydrocarbons, *Water pollution effects, Sediments, Paleolimnology, DDD, DDT, Dieldrin, Daphnia, Norfolk Broadland, United Kingdom.

Mechanisms which might have caused a switch from submerged plant dominance to phytoplankton dominance in a series of shallow lakes, the Norfolk Broads, during the 1950s and 1960s, are reviewed. It is argued that a likely mechanism was poisoning of the community of Cladocera which graze on algae and are associated with the plants. This allowed phytoplankton to take advantage of the increased nutrient loadings and to increase. The 1950s and 1960s were periods of liberal organochlorine pesticide use. Cladocera are particularly susceptible to organochlorine toxicity. Sediment cores were taken from Hoveton Great Broad, in which the switch to phytoplankton has occurred, and from two Broads (Upton and Martham South Broads) in which submerged plants are still dominant. Analyses were made for cladoceran remains, diatoms and molluscs. Cross dating with previously taken dated cores allowed time-scales to be applied. In Hoveton Great Broad, a switch from clear water-associated chydorids to turbid water forms was found to coincide with the loss of aquatic plants in the 1950s. No Daphnia remains were found. In the other two Broads, clear water chydorids, mostly plant-associated, were found throughout the cores. Residues of dieldrin (HEOD), DDD and TDE were found in the Hoveton Great Broad cores, with the DDT derivatives particularly associated with the end of the phase of submerged plant dominance and the beginning of that of phytoplankton dominance. Bosmina remains became more abundant after this point. Pesticide residues were scarce in the cores from the other two Broads and did not form any particular pattern. Residues of polychlorinated biphenyls were widespread in all cores. Calculation of DDT concentration in the water at the time the sediments with greatest concentrations of residue were laid down suggests that concentrations above typical LC50 values for Daphnia species could have been present. (See W90-01320 thru W90-01321) (Author's abstract)
W90-01322

**LONG-TERM CHANGE IN THE COASTAL BIOTA OF HATAKEJIMA ISLAND, (JAPANESE).**
1-10-18 Wakamatsu-cho, Fuchi-shi, Tokyo 183, Japan.
S. Ohgaki.
Japanese Journal of Ecology JJECDN, Vol. 39, No. 1, p 27-36, April 1989. 3 fig, 5 tab, 44 ref. English summary.

Descriptors: *Eutrophication, *Coastal waters, *Animal populations, *Plant populations, *Population dynamics, *Water pollution effects, *Japan, *Water temperature, Mollusks, Echinoderms, Crustaceans, Hatakejima Island, Invertebrates, Seashores.

Literature on the recent changes in the coastal biota of Hatakejima Island is reviewed and possible causes of the changes are explored. 621 species of animals were recorded on the island's seashore; 3/4 of them are invertebrates. The coastal biota has prominently changed in the last 3 decades: 64 species (>10%) increased or decreased conspicuously. The number of decreasing species was 5 times greater than that of the increasing ones. The decline in number of species was more obvious in molluscs and echinoderms than crustaceans. Water pollution seems to be an important cause of the observed changes. Oligotrophic species decreased and eutrophic species increased. Several species have disappeared only from the bay-head side of the island where pollution has been serious. Some circumstantial evidence suggests that the changes are also due to low temperatures in winter and harvesting of edible species by local people. (Author's abstract)
W90-01325

**NUVAN USE IN SALMON FARMING: THE ANTITHESIS OF THE PRECAUTIONARY PRINCIPLE.**
Marine Conservation Society, Ross-on-Wye (England).
For primary bibliographic entry see Field 8I.
W90-01328

**SELF-POLLUTION BY SCOTTISH SALMON FARMS.**
Nature Conservancy Council, Peterborough (England).
For primary bibliographic entry see Field 8I.
W90-01329

**ENVIRONMENTAL MONITORING OF CAGED FISH FARMING IN MACROTIDAL ENVIRONMENTS.**
Field Studies Council, Pembroke (Wales). Oil Pollution Research Unit.
For primary bibliographic entry see Field 8I.
W90-01330

**BAHIA LAS MINAS OIL SPILL: HYDROCARBON UPTAKE BY REEF BUILDING CORALS.**
Bermuda Biological Station for Research, Ferry Reach.
For primary bibliographic entry see Field 5B.
W90-01332

**MEIOBENTHIC AND MACROBENTHIC COMMUNITY STRUCTURE ALONG A PUTATIVE POLLUTION GRADIENT IN SOUTHERN PORTUGAL.**
Marine Biological Association of the United Kingdom, Plymouth (England).
M. C. Austen, R. M. Warwick, and M. C. Rosado.
Marine Pollution Bulletin MPNBAZ, Vol. 20, No. 8, p 398-405, August 1989. 5 fig, 1 tab, 21 ref.

Descriptors: *Path of pollutants, *Benthic fauna, *Water pollution effects, *Wastewater pollution, Species composition, Species diversity, Ria Formosa, Portugal.

Macro- and meiobenthos were sampled from Ria Formosa, Portugal along putative sewage pollution gradients in summer 1987 and winter 1988. The status of the benthos was assessed using multidimensional scaling ordination, ABC plots, and a variety of univariate indices of community structure. Meiobenthos in both seasons and macrobenthos in winter appeared to respond to sewage enrichment only in the immediate vicinity of the sewage outfalls and channels but ABC plots indicated that macrobenthic communities were moderately stressed throughout the area in summer. In the summer, human digging for shellfish results in considerable sediment turnover. Since meiofauna may be less affected by physical sediment disturbance than macrofauna this may explain why the macrofauna communities were apparently disturbed relative to the meiofauna even beyond the influence of the sewage. Sampling meiofauna with the macrofauna significantly increased our under-

standing of man's impact in this area. There was little correlation between macro- and meiobenthos in diversity, abundances, number of taxa and biomass and these indices gave no indication of an organic enrichment gradient. (Author's abstract)
W90-01333

**PRODUCTION ESTIMATES OF THE DOMINANT TAXA OF CHIRONOMIDAE (DIPTERA) IN THE MODIFIED, RIVER WIDAWKA AND THE NATURAL, RIVER GRABIA, CENTRAL POLAND.**
Lodz Univ. (Poland). Inst. of Environmental Biology.
For primary bibliographic entry see Field 2H.
W90-01375

**DESCRIPTIVE ANALYSIS AND CLASSIFICATION OF BENTHIC COMMUNITIES IN SOME MEDITERRANEAN COASTAL LAGOONS (CENTRAL ITALY).**
Universita degli Studi 'La Sapienza', Rome (Italy). Dipt. di Biologia Animale e dell 'Uomo.
For primary bibliographic entry see Field 2L.
W90-01381

**FEASIBILITY OF USING SATELLITES FOR DETECTION OF KINETICS OF SMALL PHYTOPLANKTON BLOOMS IN ESTUARIES: TIDAL AND MIGRATIONAL EFFECTS.**
Versar, Inc., Columbia, MD.
For primary bibliographic entry see Field 7B.
W90-01393

**BIOAVAILABILITY AND TOXICITY OF METALS AND HYDROPHOBIC ORGANIC CONTAMINANTS.**
Oak Ridge National Lab., TN. Environmental Sciences Div.
For primary bibliographic entry see Field 5B.
W90-01509

**EFFECTS OF HUMIC SUBSTANCES ON METAL SPECIATION.**
Georgia Inst. of Tech., Atlanta. School of Geophysical Sciences.
For primary bibliographic entry see Field 5F.
W90-01510

**IMPACT OF INCREASING ATMOSPHERIC CARBON DIOXIDE CONCENTRATIONS UPON RESERVOIR WATER QUALITY.**
Salford Univ. (England). Dept. of Mathematics and Computer Science.
For primary bibliographic entry see Field 2B.
W90-01585

**DUTCH NATIONAL RESEARCH PROGRAMME ON SEWERAGE AND WATER QUALITY.**
For primary bibliographic entry see Field 5G.
W90-01640

**ESTIMATING THE RELIABILITY OF REGIONAL PREDICTIONS OF AQUATIC EFFECTS OF ACID DEPOSITION.**
Oak Ridge National Lab., TN. Environmental Sciences Div.
R. H. Gardner, J. P. Hettelingh, J. Kamari, and S. M. Bartell.
Available from the National Technical Information Service, Springfield, VA 22161, as DE88-009703. Price codes: A03 in paper copy, A01 in microfiche. Report No. CONF-8704291--1, (1987). 44p, 8 fig, 6 tab, 25 ref. DOE Contract DE-AC05-840R21400. NSF Grant BSR 8516951.

Descriptors: *Water pollution effects, *Acid rain, *Aquatic environment, *Acid rain effects, *Data interpretation, RAINS, Sensitivity analysis, Soil properties, Silicates, Hydrogen ion concentration, Prediction.

Predictions from the RAINS Lake Module (RLM) and data from Finno-Scandia are compared to: (1) identify and quantify errors associated with extrapolation of site-specific information; (2) test and quantify current abilities to perform useful extrapolation; and (3) establish guidelines and limits for the role of data and models in regional assessments. The results show that simple procedures can be used to calibrate the RLM and quantify the prediction errors. Sensitivity and uncertainty analysis identified SOILT (the soil-thickness of the catchment) and SIBRC (the silicate buffer rate) as the key model parameters. When SOILT and SIBRC were calibrated for region 1 of Finland the mean and variance of predicted pH values adequately matched the data. The extrapolation of these results to other regions indicates that broad geographic areas exist where errors of extrapolation have little effect on the accuracy of model predictions. Although the pattern of predictions with time can not be verified by data, the consistency of predictions indicates that net changes between future scenarios produce similar results independent of the method used to calibrate model parameters. The challenge of using complex site-specific models for broad-scale predictions is to identify processes that are critical to a region and thus define, on first principles, the natural boundaries of systems behavior. Methods that identify these boundaries may allow model predictions to have errors that are small relative to the natural variability of the system. (Author's abstract)
W90-01724

**EFFECT OF SIMULATED ACID RAIN ON THE GROWTH AND YIELD OF SOYBEAN PLANTS GROWN IN POTS, (IN JAPANESE).**
Y. Kohno.
Available from National Technical Information Service, Springfield, VA 22161 as DE88-752545. Price codes: E03 in paper copy. Report no. CRIEU-87015. 20p, 1 fig, 10 tab, 29 ref. English summary.

Descriptors: *Acid rain, *Acid rain effects, *Soybeans, *Japan, Sulfates, Nitrates, Chlorides, Necrosis, Hydrogen ion concentration, Growth, Reproduction.

Soybean plants (Glycine max) grown in plastic pots were exposed to simulated acid rain to asses effects of acid rain on crop yields. The major ion components of the simulated acid rain were: sulfate, nitrate and chloride, in a concentration ratio on the basis of weight of 2:1:1 which is equivalent to the average ambient rain samples in Japan. The frequency of rain events was twice a week during a growing season, the duration of events was 1 hour and the amount of precipitation in each event was 2.2 or 5.0 mm. When simulated acid rain was below pH 3.0, visible symptoms such as small pale brown necrotic spots developed in the younger trifoliate leaves. However, no visible symptoms were observed over pH 3.0. Tissue dry weight, trifoliate leaf area and dry seed yield were not significantly affected by exposure to simulated acid rain over pH 3.0. Leaf areal growth, total dry weight and dry seed yield of soybean plants exposed to simulated acid rain at pH 2.0 during growing season, were significantly reduced. Yield reduction in one of the experiments was due to decreased total pod number/plant; that in the second experiment was due to decreased seed mass/pod. (Author's abstract)
W90-01729

**ENVIRONMENTAL IMPACT ON OMBROTROPHIC BOGS IN NORTHWESTERN EUROPE: EFFECTS OF ACID RAIN AND NITROGEN POLLUTION ON RAISED BOGS AND BLANKET BOGS OF NORTHWEST EUROPE AND PRACTICAL MEANS OF CONSERVATION.**
Miljoestyrelsen, Roskilde (Denmark). Luftforureningslaboratoriet.
A. Voight, and I. Johnsen.
Available from National Technical Information Service, Springfield, VA 22161 as DE88750390/GAR, Price codes: A04 in paper copy, A01 in microfiche. Report MST-LUFT-A-114. March 1987. 61p, 4 fig, 5 tab, 60 ref, 3 append. English summary.

Descriptors: *Water pollution control, *Acid rain effects, *Acid rain, *Bogs, *Peat bogs, *Europe, Nitrogen, Sulfur, Drainage, Vegetation, Buffer zones.

Along a gradient in atmospheric deposition of nitrogen and sulphur, 11 raised bogs (ombrotrophic mires) and 3 blanket bogs in Sweden, Denmark, the Federal Republic of Germany, the Netherlands, United Kingdom (Wales) and Ireland were investigated for vegetation composition, content of nitrogen and sulphur in plants and peat, and plant accessible cations. The vegetation composition showed beginning changes, which could be related to air pollution, in the most affected bogs in Germany, Holland and partially in Denmark. The picture was blurred by the overlying drainage effects. Nitrogen and sulfur content was significantly higher in peat moss plants (Sphagnum) from more polluted bogs, and a strong correlation was found with estimated amounts of nitrogen and sulphur deposition, implying that peat mosses are good indicators of air pollution. Control of emissions, raising of the water level to bog surface, a buffer zone with control of fertilization and forest around the bogs (lagg forest) are recommended as conservation measures. (Author's abstract)
W90-01741

**SURVEY ON THE EFFECT OF THE DISCHARGE OF WASTE FROM TITANIUM DIOXIDE PRODUCTION IN THE GERMAN BAY (HELIGOLAND BAY), (UEBERBLICK UEBER AUSWIRKUNGEN DER VERKIAPPUNG VON ABFAELLEN AUS DER TITANDIOXIDPRODUKTION IN DER DEUTSCHEN BUCHT).**
Bundesforschungsanstalt fuer Fischerei, Hamburg (Germany, F.R.). Inst. fuer Kuesten- und Binnenfischerei.
For primary bibliographic entry see Field 5B.
W90-01744

***TOXICOLOGICAL SIGNIFICANCE OF THE* CHEMICAL REACTIONS OF AQUEOUS CHLORINE AND CHLORAMINES.**
Old Dominion Univ., Norfolk, VA. Dept. of Chemical Sciences.
For primary bibliographic entry see Field 5F.
W90-01762

## 5D. Waste Treatment Processes

**EFFECTS OF THE EMERGENCE OF A NEW HEAVY DUTY LIQUID DETERGENT CATEGORY ON THE REMOVAL OF SURFACTANTS AND ON THE TOXICITY OF THE EFFLUENT OF A MUNICIPAL SEWAGE TREATMENT PLANT.**
Procter and Gamble European Technical Center, Brussels (Belgium).
E. Matthijs, A. Rottiers, H. de Henau, H. Jendreyko, and H.-G. Korber.
Journal for Water and Wastewater Research ZWABAQ, Vol. 22, No. 4, p 151-157, 1989. 4 fig, 5 tab, 16 ref.

Descriptors: *Activated sludge process, *Wastewater treatment, *Detergents, *Surfactants, Liquid detergents, Municipal wastewater.

Since heavy duty liquid detergents bring more surfactants into the wash than powdered detergents, their increasing market share will result in the discharge of more surfactants to municipal sewage systems. Extensive studies, performed in an activated sludge sewage treatment plant and in laboratory experiments with continuous activated sludge test systems, have shown that a replacement of up to 50% of granular detergents by heavy duty liquid detergents has no adverse effect on the performance of the activated sludge system, nor on the toxicity of the treated effluent towards fish. (Author's abstract)
W90-00986

**EXAMINATIONS ON A RESIN'S CAPACITY OF ADSORPTION FOR PHENOLIC COMPOUNDS IN WATERS (1ST COMMUNICA-**

**TION) (UNTERSUCHUNGEN ZUR ADSORPTIONSFAHIGKEIT EINES HARZES AN PHENOLISCHEN VERBINDUNGEN IN WASSERN (I. MITT.)).**
Kreiskrankenhaus, Juterbogerstrabe 68, DDR-1701 Treuenbrietzen, E. Germany.
V. H. Thielemann.
Journal for Water and Wastewater Research ZWABAQ, Vol. 22, No. 4, p 167-169, 1989. 1 fig, 3 ref. English summary.

Descriptors: *Resins, *Adsorption, *Phenols, *Wastewater treatment, *Ion exchange, Waste recovery.

In the field of wastewater treatment the trend toward biological treatment processes is unmistakable. However, in the future, processes like extraction, ion exchange, adsorption and the like cannot be ignored, on the one hand for waste-product recovery, and on the other for the biological degradation necessary to guarantee reduction of pollutant concentrations. The adsorptive capacity of a resin, synthesized by the polymerization of vinyl acetate using a silico-organic interlinker and that could be appropriate as an adsorbent in wastewater purification, has been tested for phenolic compounds by an experiment on the semi-technical scale under practical conditions. The investigation of the capacity for phenol and 4-chlorphenol by loading the resins to saturation with known adsorbates gave the following values: phenol capacity by weight--446 mg/g water-free resin, chlorphenol capacity by weight--1446 mg/g water-free resin; phenol capacity by volume--270 mg/g water-free resin; and chlorphenol capacity by volume--637 mg/g water-free resin. (Shidler-PTT)
W90-00989

**DETERMINATIONS FOR BIOLOGICAL REGENERATION OF ACTIVATED CARBON LOADED WITH TOXIC SUBSTANCES (UNTERSUCHUNGEN ZUR BIOLOGISCHEN REGENERATION VON SCHADSTOFFBELADENER AKTIVKOHLE).**
Technische Univ. Hamburg-Harburg (Germany, F.R.).
V. H. Gulyas, and J. Holst.
Journal for Water and Wastewater Research ZWABAQ, Vol. 22, No. 4, p 170-174, 1989. 5 fig, 19 ref. English summary.

Descriptors: *Wastewater treatment, *Phenols, *Methane, *Biological wastewater treatment, *Activated carbon, *Aerobic treatment, Dichloromethane, Adsorption, Microorganisms, Hydrogen peroxide treatment, Regeneration.

The efficiency of aerobic biological batch processes to regenerate activated carbon loaded with 5% phenol or 30% dichloromethane has been investigated by means of phenol and dichloromethane adsorption isotherms. Microorganisms adapted to the toxic substances of concern were employed for regeneration. Activated carbon loaded with phenol was biologically regenerated. However, continuous contact of microorganisms with phenol-containing activated carbon for 2 weeks led to a low adsorption capacity. Adsorption following hydrogen peroxide treatment of the biologically regenerated carbon was less than by loaded carbon. If dichloromethane-loaded activated carbon was agitated by microorganisms adapted for 34 days to dichloromethane as a single carbon source a degradation of dichloromethane could be demonstrated which was overlayed by stripping. (Author's abstract)
W90-00990

**NEW MINERAL-CARBON SORBENT: MECHANISM AND EFFECTIVENESS OF SORPTION.**
Instytut Ksztaltowania Srodowiska, Wroclaw (Poland).
M. Korczak, and J. Kurbiel.
Water Research WATRAG, Vol. 23, No. 8, p 937-946, August 1989. 10 fig, 9 tab, 22 ref.

Descriptors: *Wastewater treatment, *Sorbents, *Industrial wastes, Municipal wastes, Sorption, Concentration, Temperature, Contact time, Intraparticle diffusion, Structure.

The mechanism and effectiveness of a new mineral-carbon sorbent, produced from spent fuller's earth after lubricating oil rafination, were evaluated for wastewater treatment. The sorbent was produced by carbonization of organic compounds at 623 K in the presence of sulfuric acid. The surface area of the sorbent is 133 sq m/g and its structure contains numerous mesopores. Acidic and basis groups are present of the sorbent surface. The influence of the sorbent characterization on the sorbent surface, contact time, temperature, initial sorbate concentration and sorbate chemical properties has been determined on the basis of investigations of sorption of selected compounds. Functional groups on the surface of the sorbent affected sorption of compounds occurring in the ionic form. Intraparticle diffusion was the sorption rate-controlling step. Increase in the initial concentration of the sorbate affected the rate and capacity of the sorption; sorbate functional group analysis indicated a negative effect of hydroxyl groups. Sorbate molecular mass had a significant effect on the sorption, while its solubility and polarity were insignificant. The results were confirmed with industrial and municipal waste. The best effects were obtained with wastewaters containing large molecules having electrostatic charge from a textile dyehouse. (Author's abstract)
W90-00991

**DISTRIBUTION AND ROLE OF BACTERIAL NITRIFYING POPULATIONS IN NITROGEN REMOVAL IN AQUATIC TREATMENT SYSTEMS.**
New Hampshire Univ., Durham. Dept. of Civil Engineering.
T. Taylor Eighmy, and P. L. Bishop.
Water Research WATRAG, Vol. 23, No. 8, p 947-955, August 1989. 7 fig, 4 tab, 30 ref. NSF (CEE-8209851).

Descriptors: *Nitrogen removal, *Macrophytes, *Nitrogen fixing bacteria, *Wastewater treatment, *Nitrification, *Denitrification, Elodea, Myriophyllum, Duckweed, Ammonium, Nitrates, Mass balance.

The distribution and role of autotrophic nitrifying bacterial populations in nitrogen removal in aquatic macrophyte-based aquatic systems (ATSs) was assessed. Pilot-scale systems using the macrophytes Elodea nuttalli, Myriophyllum heterophyllum and Lemna minor were used to evaluate macrophyte type and seasonal effects on nitrifier distributions. Distributions of pelagic, epiphytic and sedimentary nitrifiers were determined using a most probable number (MPN) microtechnique. Nitrifying populations are present in the reactors year-round, and season has no apparent effect on distribution. Relative abundances between pelagic, epiphytic and sedimentary populations are similar. Ammonium oxidizers are more abundant than nitrite oxidizers. Seasonal net ammonium removal rates, net nitrification rates and nitrogen budgets were also conducted on Elodea nuttalli reactors. Rates of net ammonium removal and net nitrate production are very much affected by macrophyte productivity. The data suggest that nitrification is relatively constant but that reactor nitrate levels are governed both by macrophyte utilization of ammonium or nitrate and by denitrification. Mass balances on total nitrogen (TN) support these observations. When Elodea nuttalli productivity is low, detrital sedimentation is the predominant nitrogen removal mechanism. When productivity is high, macrophyte uptake of ammonium or nitrate and denitrification are the predominant nitrogen removal mechanisms; thus indicating that nitrifiers play a significant role in nitrogen removal in ATSs. In terms of using ATSs for nitrogen control for sewered small communities, consideration of macrophyte type, harvesting strategy and detrital sediment collection and removal should be given to control effluent TN, ammonium and nitrate. (Author's abstract)
W90-00992

**EFFECT OF WATER TREATMENT PROCESSES ON THE REMOVAL OF HEPATOTOXINS FROM MICROCYSTIS AND OSCILLATORIA CYANOBACTERIA: A LABORATORY STUDY.**
Valtion Teknillinen Tutkimuskeskus, Espoo (Finland). Elintarvikelaboratorio.
K. Himberg, A. M. Keijola, L. Hiisvirta, H. Pyysalo, and K. Sivonen.
Water Research WATRAG, Vol. 23, No. 8, p 979-984, August 1989. 1 fig, 6 tab, 10 ref.

Descriptors: *Toxins, *Water treatment, *Cyanophyta, *Algal toxins, *Hepatotoxins, *Drinking water, Microcystis, Oscillatoria, Flocculation, Filtration, Chlorination, Activated carbon, Ozonation, Liquid chromatography.

The behavior of hepatotoxins from Microcystis and Oscillatoria cyanobacteria in some common water treatment processes was investigated on the laboratory scale in order to obtain data on their potential transfer to drinking water. Two toxins were separated from both of the freeze-dried cyanobacterial materials used in the experiments, a natural bloom consisting of M. wesenbergii and M. viridis and a laboratory-grown culture of O. agardhii. The concentrations of all four toxins before the treatments were between 30 and 60 micrograms/L. The investigated water treatment processes, selected from among methods applied in Finland, were: (1) Al2 (SO4)3 flocculation with sand filtration and chlorination; (2) FeCl3 flocculation with sand filtration and chlorination; (3) addition of activated carbon powder with Al2(SO4)3 flocculation, sand filtration and chlorination; (4) Al2(SO4) flocculation, sand filtration, activated carbon filtration and chlorination; and (5) ozonation with Al2(SO4)3 flocculation, sand filtration and chlorination. The conventional flocculation-filtration-chlorination procedures resulted in a relatively small decrease in the toxin concentrations. Activated carbon powder in low doses did not improve the results, but activated carbon filtration as well as ozonation completely removed the toxins. The toxin concentrations were determined by high performance liquid chromatography. The proper functioning of the treatment processes was monitored by measurement of the KMnO4 value, turbidity and flocculation chemical residues. (Author's abstract)
W90-00996

**EFFECT OF NICKEL(II) ON ACTIVATED SLUDGE.**
Middle East Technical Univ., Ankara (Turkey). Dept. of Environmental Engineering.
U. Yetis, and C. F. Gokcay.
Water Research WATRAG, Vol. 23, No. 8, p 1003-1007, August 1989. 8 fig, 2 tab, 15 ref. AFP Grant AFP-85-03-11-01.

Descriptors: *Wastewater treatment, *Activated sludge process, *Nickel, *Toxicity, Carbon, Flocculation.

There is little information in the literature to describe the effects of heavy metals on activated sludge kinetics. The purpose of this study is to evaluate the toxic effect of nickel on activated sludge. Different concentrations of Ni(II) (5.0, 10.0, and 25.0 mg/L) were maintained in a laboratory-scale completely mixed activated-sludge unit, without recycle, treating simulated wastewater. The feed solution contained 650 mg/L protein (corresponding to 1300 mg/L COD) as a source of carbon. Experimental results indicated that the treatment efficiency was not adversely affected by the presence of nickel up to a concentration of 10.0 mg/L. However, a concentration of 25.0 mg/L Ni(II) caused serious upsets in the system, while 5.0 mg/L Ni(II) in feed solution had some stimulatory effects. The maximum specific growth rate of the culture also doubled when the nickel concentration was 5.0 mg/L and better floc formation was noticed at this nickel concentration. (Author's abstract)
W90-00999

**OZONE DOSE-RESPONSE OF ESCHERICHIA COLI IN ACTIVATED SLUDGE EFFLUENT.**
Alberta Univ., Edmonton. Dept. of Civil Engineering.
G. R. Finch, and D. W. Smith.
Water Research WATRAG, Vol. 23, No. 8, p 1017-1025, August 1989. 5 fig, 3 tab, 30 ref. Nat.

Sci. and Eng. Res. Council of Canada Grant A1010 and Alberta Env. Res. Trust Grant TO937.

Descriptors: *Wastewater treatment, *Activated sludge process, *Ozone, *Disinfection, Model studies, Pilot-scale studies, Bench-scale experiments, Contact time.

The response of E. coli ATCC 11775 in activated sludge effluent to various doses of ozone and for various contact times was studied using batch and semi-batch reactors at bench-scale and pilot-scale under controlled environmental conditions. The results indicated that there was no significant effect associated with contact time or scale. Also, the empirical dose-response form described by the U.S. EPA for sizing ozone wastewater disinfection systems was found to have lack-of-fit over the experimental region studied. The inadequacy of the model was confirmed at both scales. It was found that the bench-scale experiments provided a reasonable estimate of the required ozone dose to achieve a specified reduction of bacteria thereby potentially eliminating the need for costly pilot-scale feasibility studies in many cases. (Author's abstract)
W90-01001

**CHEMICAL OXYGEN DEMAND (COD) USING MICROWAVE DIGESTION.**
Universidade Estadual de Campinas (Brazil). Inst. de Quimica.
For primary bibliographic entry see Field 7B.
W90-01007

**CONTROL STRATEGIES FOR COMBINED SEWER OVERFLOW.**
Piper and Marbury, Washington, DC.
J. C. Hall, C. L. Rissetto, and J. M. Santarella.
Journal - Water Pollution Control Federation JWPFA5, Vol. 61, No. 8, p 1408-1413, August 1989. 3 ref.

Descriptors: *Storm wastewater, *Combined sewer overflows, *Water pollution prevention, *Legal aspects, Permits, Public policy, Regulations, Water quality standards.

According to EPA estimates there are 15,000-20,000 combined sewer overflow discharge points nationwide, most of which serve 58 major cities along the Eastern seaboard, the upper Midwest, and the Northern Pacific states. Combined sewer discharges often contain high levels of organic and toxic wastes. EPA has recently developed a national combined sewer overflow control policy which states that 'combined sewer overflow point sources currently discharging without a permit are unlawful and must be permitted or eliminated.' The EPA combined sewer overflow permitting strategy requires EPA regional offices and NPDES (National Pollutant Discharge Elimination System)-approved states to identify the communities with combined sewer systems and the particular combined sewer overflow discharge points within these communities. After discharge points have been identified, priorities for the permitting of unpermitted or insufficiently permitted combined sewer overflow discharges should be set. Permits are required to ensure compliance with state water quality standards. (Peters-PTT)
W90-01047

**DESTRUCTION OF ENTERIC BACTERIA AND VIRUSES DURING TWO-PHASE DIGESTION.**
Cincinnati Univ., OH. Dept. of Civil and Environmental Engineering.
K. M. Lee, C. A. Brunner, J. B. Farrell, and A. E. Eralp.
Journal - Water Pollution Control Federation JWPFA5, Vol. 61, No. 8, p 1421-1429, August 1989. 1 fig, 11 tab, 12 ref.

Descriptors: *Wastewater treatment, *Biodegradation, *Anaerobic digestion, *Bacteria, *Viruses, Coliforms, Escherichia coli, Enteroviruses, Streptococcus, Temperature effects, Pathogens.

The pathogenic microorganism destruction obtained during two-phase anaerobic digestion was compared to wastewater treatment sludge. Operation was draw-and-fill. Total digester residence time of 10 days and 20 days were evaluated. Evaluations were carried out at 35 and 53C. Microorganisms measured included fecal coliforms, Escherichia coli, fecal streptococci, and enterovirus. Pathogen reductions were compared to those calculated from a kinetic relationship developed specifically for draw-and-fill operation. Ascaris were added to digested sludge and held at 53C for up to 8 hours to observe their decline with time under thermophilic conditions. Common digester operating parameters were also measured. At the thermophilic temperature of 53C essentially all the microorganisms measured were reduced to undetectable levels. At 35C, two-phase digestion achieved from 0.48 to 0.91 greater log reduction of bacterial indicators, but essentially the same reduction in virus. (Author's abstract)
W90-01048

**TREATMENT OF A METAL-CUTTING-FLUIDS WASTEWATER USING AN ANAEROBIC GAC FLUIDIZED-BED REACTOR.**
General Motors Research Labs., Warren, MI. Environmental Science Dept.
B. R. Kim, M. J. Matz, and F. Lipari.
Journal - Water Pollution Control Federation JWPFA5, Vol. 61, No. 8, p 1430-1439, August 1989. 7 fig, 1 tab, 7 ref.

Descriptors: *Wastewater treatment, *Industrial wastewater, *Activated carbon, *Metal-finishing wastes, Biodegradation, Chemical oxygen demand, Anaerobic conditions.

An anaerobic granular activated carbon (GAC) fluidized-bed process was studied to treat a simulated wastewater containing eight selected metal-cutting fluids at various loadings. With an influent chemical oxygen demand of 3300 mg/L, an empty bed contact time (EBCT) of 0.36 h, and after activated carbon adsorption capacity was exhausted, the effluent COD was reduced by approximately 60%. This COD residual did not change for several EBCT's indicating that residual organics are nonbiodegradable in an anaerobic environment. Investigation indicates that more than one-half of the residual organics are biodegradable in an aerobic environment, suggesting that an anaerobic treatment followed by an aerobic polishing step can improve effluent quality. The initially low effluent COD concentration indicates that organics in the simulated wastewater are easily adsorbable and that periodic replacement of the GAC in the reactor is an option to improve effluent quality. (Author's abstract)
W90-01049

**STABILITY OF NITRITE BUILD-UP IN AN ACTIVATED SLUDGE SYSTEM.**
NovaTec Consultants, Inc., Vancouver (British Columbia).
O. Turk, and D. S. Mavinic.
Journal - Water Pollution Control Federation JWPFA5, Vol. 61, No. 8, p 1440-1448, August 1989. 6 fig, 5 tab, 24 ref.

Descriptors: *Wastewater treatment, *Activated sludge, *Denitrification, *Nitrogen removal, Nitrites, Ammonia.

The feasibility of removing nitrogen from highly nitrogenous wastes by a shortened nitrification/denitrification pathway involving nitrite production and reduction was investigated. Free ammonia was an effective differential inhibitor of unacclimated populations. Nitrite build-up was achieved in all runs by intermittent contact with a high free ammonia level. Nitrite build-up could not be sustained indefinitely, due to acclimation of the nitrite oxidizers to free ammonia. The most effective measure investigated to overcome the effects of acclimation was internal recirculation. Its effectiveness was due to the continued ability of free ammonia to maintain some degree of inhibitor on an acclimated population of nitrite oxidizers. As a result, their nitrifying activity lagged that of the ammonium oxidizers, allowing nitrite build-up to sustain itself. The experimental program confirmed the possibility of successfully operating a nitrogen removal system through the shortened pathway. (Author's abstract)
W90-01050

**OXYGEN TRANSFER IN CLEAN AND PROCESS WATER FOR DRAFT TUBE TURBINE AERATORS IN TOTAL BARRIER OXIDATION DITCHES.**
Wisconsin Univ., Madison. Dept. of Civil Engineering.
W. C. Boyle, M. K. Stenstrom, H. J. Campbell, and R. C. Brenner.
Journal - Water Pollution Control Federation JWPFA5, Vol. 61, No. 8, p 1449-1463, August 1989. 9 fig, 9 tab, 9 ref.

Descriptors: *Aeration, *Wastewater treatment, *Secondary wastewater treatment, Testing procedures, Energy savings, Oxygen demand, Total barrier oxygen ditches, Radioactive tracers.

Total barrier oxidation ditches (TBODs) have been installed over the past 5 years in the U.S. under the innovative provisions of the U.S. Environmental Protection Agency (EPA) Innovative and Alternative (I/A) Technology Construction Grants Program. One I/A feature of this system is the claimed energy savings due to high oxygen transfer efficiency of draft tube submerged turbine aerators (DTTAs). In an effort to evaluate the oxygen transfer performance of DTTAs in the TBOD configuration (with J-tube extenders to transfer aerated mixed liquor to the downstream of the barrier wall), full-scale testing programs were conducted at two locations using a variety of clean and process water testing techniques. In clean water, the American Society of Civil Engineers (ASCE) sanctioned testing procedure was used and compared to the radioactive tracer (radiotracer) procedure and a dissolved oxygen (DO) mass balance across the DTTA/J-tube assembly. The radiotracer procedure was also used in process water testing and compared to the off-gas procedure and a long-term mass balance on oxygen demanding material. All test methods agreed very closely, indicating that the ASCE procedure can be used in noncomplete mixing geometries, such as oxidation ditches. The precision of the various methods was different. (Author's abstract)
W90-01051

**POTENTIAL INTERFERENCES IN CATALYSIS OF THE UNSTEADY-STATE REAERATION TECHNIQUE.**
Industrial Gases, Inc., Danbury, CT.
D. W. Terry, and L. T. Thiem.
Journal - Water Pollution Control Federation JWPFA5, Vol. 61, No. 8, p 1464-1470, August 1989. 8 fig, 5 tab, 16 ref.

Descriptors: *Wastewater treatment, *Aeration, Testing procedures, Hydrogen ion concentration, Cobalt, Sulfur compounds, Chloramines.

An investigation was conducted on the effects of certain water quality parameters on the catalytic action of cobalt used in conjunction with sodium sulfite for deaeration prior to aerator performance testing. The water quality parameters included were chlorine, pH, and ammonia, along with combinations of these parameters. Without sufficient levels of dissolved cobalt, erroneous mass transfer values would be measured due to the effect of sulfite during the uptake portion of the reaeration test. A 7-L reactor with a diffused air source was constructed for the unsteady-state reaeration tests. High pH values caused cobalt to precipitate from solution. Chloramines reduced the effective catalytic properties of the cobalt even though the required concentration of cobalt remained constant in solution. (Author's abstract)
W90-01052

**HASTINGS AND BEXHILL DRAINAGE AND SEA OUTFALL SCHEMES.**
R. B. Armstrong, J. C. Foxley, N. J. Bennett, and R. G. Morley.
Journal of the Institution of Water and Environmental Management, Vol. 3, No. 2, p 135-146,

April 1989. 6 fig, 1 tab, 3 ref.

Descriptors: *Wastewater outfall, *Drainage systems, *Outfall sewers, *Sewer systems, *Water management, Storm sewers, Storm runoff, Hydraulic design, Pumping plants, Pump wells, Odor control, England.

The work now nearing completion on the Hastings and Bexhill drainage schemes is the culmination of a series of schemes conceived in the early 1960s. Most of the costly investment has taken place in the last decade in several phases which were completed in 1988. Ultimate disposal of sewage is by long sea outfall. The new works include two pumping stations and rising mains leading to a header tower serving the outfall. A number of innovations are included to overcome technical problems and reduce costs. Some problems have been experienced which are worthy of comment; the sewerage contained an unusually high sediment transport load when storm flushes occurred following long dry periods, creating difficulties with excessive grit depositing in the inlet channel instead of being passed through to the grit separation zone. Modification of the profile of the inlet channel eased the problem. The grit deposition upset the accuracy of the ultrasonic flow measuring facility at the inlet. This affected station operational control and created uneven flow distribution to the two cone pumps. The cone pumps have worked well apart from persistent problems with the drive mechanism and lay shaft. Maintenance to these items was eased by a design modification which separated the two cone pump wells to enable work on one to be done independently of the other. (Fish-PTT)
W90-01081

**ROOT-ZONE PROCESS AT HOLTBY SEWAGE-TREATMENT WORKS.**
Yorkshire Water Authority (England). North and East Div.
E. Chalk, and G. Wheale.
Journal of the Institution of Water and Environmental Management, Vol. 3, No. 2, p 201-207, April 1989. 5 fig, 2 tab, 11 ref.

Descriptors: *Biological wastewater treatment, *Marsh plants, *Wastewater treatment, *Root zone, Cost analysis, Grasses, Suspended solids, Biological oxygen demand, Ammonia, Phosphorus removal, Weed control, Slopes, Gravel, England, Performance evaluation, Reed grass.

The 'root-zone' sewage treatment process was introduced to the U.K. and Yorkshire Water in 1984, with claims that capital and operating costs were significantly less than for conventional processes. An experimental root-zone bed at Holtby (which forms part of Yorkshire Water's contribution to the evaluation of the process in the U.K.) has been designed and constructed. The reed Phragmites was planted, and their growth and the performance of the bed have been observed. Suspended solids and biological oxygen demand removal efficiencies have satisfied the predictions of the designers for the performance of a bed which is still immature, although ammonia and phosphate removals have been low. The role which is played by the reeds is considered to be minor, and it is suggested that it is too early to judge the Holtby bed either a success or a failure. Preliminary observations have been made regarding problems with weed control, optimum floor slope, maturity of the system, and the use of gravel instead of soil. (Author's abstract)
W90-01086

**IMPACT OF FLUE-GAS DESULPHURIZATION ON THE WATER ENVIRONMENT.**
Environmental Sciences Ltd., Vancouver (British Columbia).
For primary bibliographic entry see Field 5C.
W90-01088

**DESIGN AND CONSTRUCT CONTRACTS IN THE WATER INDUSTRY: 3. THE WAY AHEAD--THE CONSULTANT'S VIEWPOINT.**
Balfours, London (England).
D. C. Gibson.
Journal of the Institution of Water and Environmental Management, Vol. 3, No. 3, p 243-251, June 1989.

Descriptors: *Wastewater treatment, *Contracts, *Project planning, Civil engineering, Cost analysis, Economic aspects, Construction methods, Water management, England, Construction costs.

In the U.K., wastewater treatment plants may be constructed by adopting a design and construct approach, termed a turnkey contract strategy. This includes the design, construction, and commissioning of a complete installation under the responsibility of one contracting organization (as opposed to the traditional approach where conceptual and civil works designs are undertaken by the client's own design team, and separate construction contracts are invited for the elements of works). The turnkey approach offers the prospects of shorter overall project periods, but this will only be realized provided the purchaser has made proper financial plans to ensure that funding is available to enable the project to proceed over the reduced timescale. The high proportion of civil works, much of what is below ground in the construction of sewage treatment works, results in the dominant costs being outside the influence of process contractors, and so the more economic scheme could well be developed under the traditional multi-contract approach. (See also W90-01089 and W90-01090) (Fish-PTT)
W90-01091

**NUMERICAL APPROACH TO MULTI-STAGE BIOREACTOR KINETICS.**
Technical Univ. of Istanbul (Turkey). Dept. of Environmental Engineering.
Y. Muslu.
Journal of the Institution of Water and Environmental Management, Vol. 3, No. 3, p 252-259, June 1989. 5 fig, 4 tab, 12 ref, append.

Descriptors: *Wastewater treatment, *Biological wastewater treatment, *Solid wastes, *Activated sludge process, Numerical analysis, Effluents, Biomass, Kinetics, Retention time, Plug flow.

Work which has been carried out during the last decade has proved the importance of concentration gradients and dispersion in the performance of reactors. In multi-stage bioreactors, which are now finding increasing application in modern wastewater technology, a similar phenomenon is also observed. A numerical model has been developed to determine hydraulic and solids retention periods and effluent concentrations from activated sludge reactors-in-series when substrate utilization follows Monod kinetics. The model considers the axial change in biomass concentrations and takes all kinetic coefficients into account. By means of the numerical approach, the variation of the ratio between the hydraulic retention period of a given reactor and that of an equivalent plug flow tank with the same inlet and outlet conditions has been investigated. Using the numerical results obtained, dispersion prediction graphs are plotted for designing cascade-connected systems. (Author's abstract)
W90-01092

**IMPROVEMENTS TO ACTIVATED-SLUDGE PLANT AERATION SYSTEMS AT HAWICK AND JEDBURGH SEWAGE-TREATMENT WORKS.**
B. F. J. Wallis.
Journal of the Institution of Water and Environmental Management, Vol. 3, No. 3, p 262-272, June 1989. 6 fig, 1 tab, 4 ref, 2 append.

Descriptors: *Wastewater facilities, *Wastewater treatment, *Activated sludge process, *Aeration, Cost analysis, Mechanical equipment, Electrical equipment, Civil engineering, Water quality control, Process control, Effluents, Scotland.

In response to the requirement of the Tweed River Purification Board, Scotland, for a higher standard of effluent, improvements have been carried out to the activated sludge aeration systems at Hatwick and Jedburgh sewage treatment works, at a relatively modest cost. This was achieved by investing in mechanical and electrical equipment rather than modifying the more expensive civil engineering structures. Improvements to the effluent quality have resulted in additional power costs, but the investment in modern control systems has limited these costs. The control systems allow better process management, and it is considered that the degree of flexibility will facilitate further improvement to the operation of the works. One of the disadvantages of the approach is that, in a retrofit situation, guarantees in terms of effluent cannot be reasonably sought; consequently an element of risk is involved. (Author's abstract)
W90-01094

**EXPERIENCES WITH THE DEEP-SHAFT PROCESS AT TILBURY.**
R. A. Irwin, W. J. Brignal, and M. A. Biss.
Journal of the Institution of Water and Environmental Management, Vol. 3, No. 3, p 280-287, June 1989. 8 fig, 1 tab, 5 ref.

Descriptors: *Activated sludge process, *Wastewater treatment, *Domestic wastes, *Industrial wastewater, Hydrostatic pressure, Oxygen transfer, Mixed liquor solids, Biological oxygen demand, Suspended solids, Effluents, Water quality standards, Aeration, England.

The deep-shaft activated sludge process, which was originally developed for single-cell protein production, has been successfully applied to the treatment of high-strength domestic and industrial wastewater. The process exploits the hydrostatic pressure generated at the bottom of a column of liquid to enhance the transfer of oxygen to a rapidly-circulating mixed liquor. About forty deep-shaft plants are in operation worldwide of which four have been built in the U.K. The latest of these treats a mixed industrial and domestic wastewater at Tilbury, England, and is the largest deep-shaft plant in the world. Following plant commissioning, a three-month monitoring period showed that the biological oxygen demand and suspended solids loads were extremely variable and exceeded the design capacity of the works by approximately 40% during the month of July. Despite this, the effluent quality remained within consent limits. The computerized aeration control system was not functional during the trial period; nevertheless, considerable potential energy savings were indicated. (Author's abstract)
W90-01096

**SPECTRUM OF POLLUTANTS IN LTC WASTEWATER--A CASE STUDY.**
National Environmental Engineering Research Inst., Nagpur (India).
R. A. Pandey, N. M. Parhad, and P. Kumaran.
Journal of Environmental Science and Health (A) JESEDU, Vol. 24, No. 6, p 603-632, August 1989. 9 fig, 8 tab, 24 ref.

Descriptors: *Wastewater, *Phenols, *Ammonia, *Organic compounds, *Coal, *Cyanide, *India, Pollutants, Low temperature carbonization.

Wastewater samples were collected on three occasions from Coal Chemical Complex, Naspur, Adilabad, India. Composite samples of waste ammoniacal liquor for a period of 24 hours were also collected to evaluate the periodic variation in compositional characteristics. Low temperature carbonization (LTC) wastes contain high concentrations of various phenols, organic bases, ammonia, cyanide, thiocyanate and several other constituents of environmental concern. Fresh waste water is colorless to straw-yellow in color but changes to red or brownish red due to oxidative coupling of phenols resulting in quinone structures with C-O-C linkages. (See also W90-01120) (Author's abstract)
W90-01119

**WASTEWATER CHARACTERISTICS OF LTC PROCESS OF COAL.**
National Environmental Engineering Research Inst., Nagpur (India).
R. A. Pandey, P. Kumaran, and N. M. Parhad.

Journal of Environmental Science and Health (A) JESEDU, Vol. 24, No. 6, p 633-643, August 1989. 1 fig, 3 tab, 7 ref.

Descriptors: *Wastewater, *Coal, *Phenols, *Ammonia, *Cyanide, Low temperature carbonization, Pollutants.

Low temperature carbonization (LTC) is a process in which coal is heated (500-800 C), in absence of oxygen, yielding products like coke, tar, oil, liquor and gases. The liquor contains several pollutants like phenols, ammonia, cyanide, and thiocyanate. Therefore, the characteristics of the liquor are of significant importance, with reference to environmental pollution. The quality and quantity of liquor is dependent on the nature of the coal and process of carbonization. In the present study, the strength of the liquor has been correlated with the temperature of carbonization and the volatile matter content of coal, using Gray-King Assay apparatus for the carbonization. The present study indicates that the pollution load of liquor is directly proportional to the volatile matter content of coal. The temperature of carbonization also influences the concentration of the pollutants in the waste liquor. (See also W90-01119) (Author's abstract)
W90-01120

**MODELING AND SIMULATION OF COMPRESSIVE GRAVITY THICKENING OF ACTIVATED SLUDGE.**
Stevens Inst. of Tech., Hoboken, NJ. Dept. of Civil and Ocean Engineering.
D. A. Vaccari, and C. G. Uchrin.
Journal of Environmental Science and Health (A) JESEDU, Vol. 24, No. 6, p 645-674, August 1989. 6 fig, 2 tab, 16 ref.

Descriptors: *Wastewater treatment, *Model studies, *Activated sludge, *Sludge thickening, *Mathematical models, *Simulation analysis, Kos model.

A mathematical model of compressive thickening was developed which is based on Kos' model yet can be calibrated from measurements of concentration, concentration gradient, and bulk underflow velocity in continuous thickening experiments. The need for sensitivity and difficult measurements such as interparticle pressure or volumetric solids concentration is eliminated. Numerical programs to simulate the model are described. The model was calibrated and tested using steady state continuous thickening experiments. Unsteady state continuous thickening was studied by use of computer simulation of the model. Programs are described for nonlinear regression of the models to continuous thickening column data, and for steady state and unsteady state simulation. (Author's abstract)
W90-01121

**CHROMIUM REMOVAL BY ACTIVATED SLUDGE.**
Louisiana State Univ., Baton Rouge. Dept. of Civil Engineering.
W. F. Wimberley, and M. E. Tittlebaum.
Journal of Environmental Science and Health (A) JESEDU, Vol. 24, No. 6, p 571-588, August 1989. 2 fig, 3 tab, 10 ref.

Descriptors: *Wastewater treatment, *Chromium, *Activated sludge, Hazardous materials, National pollutant discharge elimination system limitations, Metals.

Much attention has been given to groundwater contamination due to the release of hazardous constituents from treatment and disposal facilities. Since some of the constituents entered groundwater aquifers in much shorter times than had been calculated, regulatory agencies have become concerned that hazardous constituents may be escaping from units not currently regulated under hazardous waste management programs. One of the major concerns of regulators is that unlined earthen surface impoundments in industrial wastewater treatments trains may be leaking heavy metals such as chromium and other hazardous constituents into the groundwater. The Environmental Protection Agency has moved toward bringing such impoundments under the Resource Conservation and Recovery Act regulations. In addition, EPA is now proposing to list hexavalent chromium as a hazardous air pollutant due to its possible release from the mist of cooling towers, citing hexavalent chromium's potent carcinogenicity as the primary concern. While such a listing would primarily affect worker exposure, leakage of chromium from surface impoundments could enter groundwater sources and carry exposures far beyond industrial facilities. Since hexavalent chromium has been used extensively in cooling water systems for corrosion protection, this study was undertaken to determine how efficient an operating activated sludge system was a removing hexavalent chromium from the wastewater stream. While influent hexavalent chromium concentrations were not as high as expected based on chromium usage and wastewater flows, the chromium (VI) concentrations in the plant's effluent were very small and most of the time below 0.005 mg/l. The removal of Cr(VI) based on influent and effluent sampling ranged from 34-97%, with an average removal of 83%. (Author's abstract)
W90-01122

**EPA'S PRETREATMENT PROGRAM.**
For primary bibliographic entry see Field 5G.
W90-01171

**ASSESSMENT OF DYNAMIC MODELS FOR A HIGH RATE ANAEROBIC TREATMENT PROCESS.**
Environmental Protection Service, Burlington (Ontario). Waste Water Technology Centre.
R. M. Jones, and E. R. Hall.
Environmental Technology Letters ETLEDB, Vol. 10, No. 6, p 551-566, June 1989. 6 fig, 4 tab, 18 ref.

Descriptors: *Anaerobic digestion, *Wastewater treatment, *Model studies, *Industrial wastes, *Biological wastewater treatment, Pulp wastes, Pulp and paper industry, Kraft mills, Chemical oxygen demand, Anaerobic conditions.

Advanced high rate anaerobic processes, which provide an economically attractive alternative for the treatment of concentrated industrial wastewaters, require operation to minimize the negative effects of highly variable hydraulic, organic and toxic loadings. A mechanistic dynamic model for the anaerobic process can benefit such operation by leading to an improved understanding of the phenomena governing the dynamic behavior of the process. Initial attempts to examine the adequacy of two population and four population anaerobic process models, developed previously by other researchers, are reviewed, and steady state and dynamic operating data from a high rate anaerobic pilot plant were collected. A pilot scale HYBRID reactor was operated under steady state and dynamic conditions using a pulp and paper mill effluent as a feedstock. Data collected during experimentation on the pilot plant were used to evaluate the two and four population models. Results showed that both models were adequate in qualitatively describing steady state and dynamic process behavior but would be of limited use in directly providing estimates of process variables for control purposes. Neither model could adequately predict the reduction in steady state COD removal efficiency or the decline in the gas production rate observed following a concentration step. The hydraulic and biofilm characteristics of the HYBRID reactor configuration complicated the evaluation of the models. (Friedmann-PTT)
W90-01232

**INVESTIGATION OF START-UP IN ANAEROBIC FILTERS UTILIZING DAIRY WASTE.**
Imperial Coll. of Science and Technology, London (England). Public Health Engineering Lab.
D. da Motta Marques, J. Cayless, and J. N. Lester.
Environmental Technology Letters ETLEDB, Vol. 10, No. 6, p 567-576, June 1989. 7 fig, 2 tab, 23 ref.

Descriptors: *Wastewater treatment, *Anaerobic digestion, *Filtration, *Dairy industry, *Milk, *Farm wastes, Anaerobic conditions, Organic wastes, Fatty acids, Organic loading.

Two start-up regimes for upflow anaerobic filters, one utilizing stepped organic loading and the second stepped loading with anaerobic polymer addition, were evaluated. Start-up was initiated using a synthetic ice cream waste; as loading increased, real ice cream waste was substituted. A waste COD of approximately 5000 mg/L was applied throughout the study. Organic loadings of up to 12 kg COD/cu m-d could be applied, at an HRT of 0.42 d, with COD removals > 80%. Polymer did not enhance start-up as the performances of the two reactors were indistinguishable. Total volatile fatty acids remained below 100 mg/L for most of the study. Upflow anaerobic filters appear to be well-suited to the treatment of ice cream production wastes and pilot or full-scale operations should present no difficulties. (Author's abstract)
W90-01233

**ELECTROLYTIC FLOTATION OF CHROMIUM FROM DILUTE SOLUTIONS.**
Thessaloniki Univ., Salonika (Greece). Lab. of General and Inorganic Chemical Technology.
A. I. Zouboulis, and K. A. Matis.
Environmental Technology Letters ETLEDB, Vol. 10, No. 6, p 601-612, June 1989. 12 fig, 1 tab, 18 ref.

Descriptors: *Wastewater treatment, *Metal-finishing wastes, *Flotation, *Electrolytic flotation, *Chromium, Electrolytes, Bubbles, Ions.

Electrolytic flotation, consisting of a rather unusual bubble generation technique, was applied to the removal of hexavalent chromium ion from dilute aqueous solutions at laboratory bench scale experiments. Excellent results (near 100% chromium ion removal) were obtained, under the following determined optimum conditions: initial chromium content, 10 ppm; current density, 200 A/sq m; voltage, 18 V; flotation time, 900 s; agitation, low; pH, 3-9; conductivity, 70-9000 micromhos; temperature, 293-323 K. Contrary to dispersed-air ion flotation, the pH and ionic strength of the solution were not found to be crucial parameters in electrolytic flotation. (Friedmann-PTT)
W90-01236

**MODIFIED EXTENDED AERATION PROCESS FOR REMOVAL OF CADMIUM FROM WASTEWATERS.**
Delaware Univ., Newark. Dept. of Civil Engineering.
W. L. Lowe, and A. F. Gaudy.
Biotechnology and Bioengineering BIBIAU, Vol. 34, No. 5, p 600-608, August 1989. 7 fig, 1 tab, 17 ref.

Descriptors: *Wastewater treatment, *Waste disposal, *Cadmium, *Aeration, Heavy metals, Organic sludge.

The potential of a biological process for both removal and recovery of metals and treatment and disposal of organic sludge is assessed. It has been reported in the literature that several microbial species have a considerable sorption capacity for heavy metals. Using a heterogeneous microbial population developed in a modified extended aeration activated sludge process, sorption capabilites as good as, or better than, those for individual microbial species are reported. The process may have several advantages over pure or controlled culture processes and it offers the possibility for reuse of organic matter needed to regenerate metal-sorbing biomass, as well as autodigestion of excess biomass. It is indicated that acclimation to high levels of a specific heavy metal (Cd) does not confer acclimation to another heavy metal (Cu). (Author's abstract)
W90-01254

**DEGRADATION OF NITROGUANIDINE WASTEWATER COMPONENTS IN SOIL.**
Weston (Roy F.), Inc., West Chester, PA.

R. T. Williams, W. E. Sisk, and A. R. MacGillivray.
Environmental Toxicology and Chemistry ETOCDK, Vol. 8, No. 6, p 469-475, 1989. 3 fig, 2 tab, 10 ref. U.S. Army contract purchase order no. DAAK11-85-D-0007.

Descriptors: *Microbial degradation, *Biodegradation, *Land disposal, *Fate of pollutants, *Wastewater treatment, *Nitroguanidine, Continuous-flow columns, Sulfates, Land disposal.

The degradation of nitroguanidine (NQ) wastewater components was studied using continuous-flow and perfusion soil columns. After 271 d of operation of the continuous-flow columns and 84 d of operation of the perfusion columns, only some components of NQ wastewater were completely or partially removed. Guanidine nitrate and sulfate were the most readily transformed. NQ, however, was only partially removed. Carbon supplements enhanced the transformation of both sulfate and NQ. Transformation products included nitrosoguanidine and ammonia, but not cyanoguanidine or melamine. Microbial adaptation to wastewater components was not demonstrated. Based on test data, land application of untreated wastewater is not recommended. Significant but incomplete NQ reduction was observed in both sterile and active continuous-flow soil columns. Therefore, the results are inconclusive regarding the influence of microbial activity. (Miller-PTT)
W90-01259

**ISOLATION AND CHARACTERISATION OF BACTERIA CAPABLE OF ACCUMULATING SILVER.**
Kodak Ltd., London (England). Research Div.
P. A. Goddard, and A. T. Bull.
Applied Microbiology and Biotechnology AMBIDG, Vol. 31, No. 3, p 308-313, September 1989. 4 fig, 1 tab, 32 ref.

Descriptors: *Bacteria, *Citrobacter, *Silver, *Heavy metals, *Bioaccumulation, *Municipal wastewater, *Industrial wastewater, *Wastewater treatment.

The isolation of Ag-resistant, Ag accumulating bacteria is reported. Following the screening of a number of environmental sources, Ag-resistant Enterobacteriaceae were isolated from both sewage and photographic processing effluent. The level of resistance to Ag and other heavy metals was determined for a selection of these isolates and, together with preliminary accumulation data derived from batch culture studies, one isolate, a strain of Citrobacter intermedius, was selected for further examination. The effect of Ag concentration on batch culture growth of this organism was also investigated. At or below Ag concentrations of 150 micromol/l, a lag phase of about 2 h was observed. With increasing Ag concentrations, this lag phase rose to over 12 h. Raising the level of Ag in the culture also caused a reduction in the final biomass production; this was evident even at the lowest Ag concentrations investigated. Maximum specific growth rates were also reduced as the Ag concentration was increased. This reduction occurred up to 250 micromol/l but above this concentration the specific growth rate remained at about 0.2/h until growth was inhibited above 400 micromol/l Ag. (Sand-PTT)
W90-01306

**ANALYSIS AND EVALUATION OF A WASTEWATER TREATMENT PLANT MODEL BY STOCHASTIC OPTIMIZATION.**
Santiago Univ. (Spain). Dept. of Chemical Engineering.
J. J. Casares, and J. Rodriguez.
Applied Mathematical Modelling AMMODL, Vol. 13, No. 7, p , July 1989. 12 fig, 2 tab, 12 ref.

Descriptors: *Wastewater treatment, *Model studies, *Stochastic process, *Optimization, *Wastewater facilities, *Mathematical models, Algorithms, Construction costs, Design criteria.

Stochastic optimization techniques are becoming a standard procedure for optimization of chemical and related process models, due to their simplicity and robustness. A stochastic optimization procedure, Integrated Controlled Random Search, is applied to evaluate the model of a wastewater treatment plant. Equation sequencing and design variable selection algorithms are used to solve the set of equality constraints in a simple manner, offering the right choice of design variables. Subsequently, the sensitivity of the objective function defined in terms of the total construction cost is tested with respect to the design variables selected. The results permit an interpretation of the model structure and allow the shortcomings to be removed before the optimization stage. (Author's abstract)
W90-01336

**COMPARATIVE STUDY OF THREE DYNAMIC ACTIVATED SLUDGE MODELS (ETUDE COMPARATIVE DE TROIS MODELES DYNAMIQUES DE BOUES ACTIVEES).**
Institut National de la Recherche Scientifique, Sainte-Foy (Quebec).
D. Couillard, F. D. D'Amours, and G. Patry.
Canadian Journal of Civil Engineering CJCEB8, Vol. 16, No. 3, p 400-407, June 1989. 6 fig, 7 tab, 31 ref. English summary.

Descriptors: *Wastewater treatment, *Activated sludge process, *Model studies, Nitrification, Sensitivity analysis, Biological models, Simulation analysis.

Three complete dynamic models are proposed to simulate the transient behavior of the activated sludge process. The responses obtained are compared by simulation with data found in the literature for the Norwich wastewater plant (England). A structured biological model with a bi-substrate component (particles and soluble material) together with a nitrification model which takes into account the organic nitrogen content of the effluent presents the most realistic profiles for the conditions studied. A sensitivity analysis reveals that a generalization of the model is possible if some parameters identified as critical are adjusted. (Author's abstract)
W90-01369

**NOVEL FILAMENTOUS SPORE-FORMING IRON BACTERIA CAUSES BULKING IN ACTIVATED SLUDGE.**
Puerto Rico Univ., Rio Piedras. Microbial Ecology Lab.
G. Emtiazi, M. H. Habibi, and M. Setareh.
Journal of Applied Bacteriology JABAA4, Vol. 67, No. 1, p 99-108, July 1989. 7 fig, 2 tab, 11 ref.

Descriptors: *Activated sludge process, *Biological wastewater treatment, *Bulking sludge, Bacteria, Biochemical oxygen demand, Bacterial physiology, Culturing techniques.

Several gram-positive iron bacteria were isolated from bulking sludge that were filamentous and characterized by false branching. They had sheaths with iron deposits and formed spores on modified sucrose casitone yeast extract agar. They did not grow on infusion agar for longer than one month but could withstand 80 C for 1 hr on the same medium. Adding them to sewage before aeration increased the biochemical oxygen demand of the wastewater and caused poor settling properties of activated sludges. They were the predominant filamentous microorganisms in bulking activated sludges. At present, these strains cannot be assigned to recognized taxa of Bacillus spp. or sheathed iron bacteria. These spore forming bacteria can withstand a wide variation in pH, cause corrosion, remain in the purification tanks because of their spore production, and can cause continuous bulking problems. (Author's abstract)
W90-01378

**SEWAGE PURIFICATION IN SOUTH AFRICA: QUO VADIS.**
Water Research Commission, Pretoria (South Africa).
H. N. S. Wiechers.
Water SA WASADV, Vol. 15, No. 3, p 141-146, July 1989. 3 fig, 9 tab, 20 ref.

Descriptors: *Wastewater, *Wastewater treatment, *South Africa, *Wastewater management, Sludge, Contact beds, Sludge digestion, Composting, Wastewater renovation, Activated sludge process, Activated sludge.

Projected future demographic changes in South Africa, particularly accelerated urbanization, will result in rapidly increasing pollution loads on the water environment, should appropriate action not be taken. A strategy is proposed to combat this threat, consisting of three approaches, including high technology, low technology, and resource utilization. Examples of high technology that should be considered include modified activated sludge processes such as Bardenpho, UCT and Phostrip, membrane processes, and water reclamation. Examples of low technology that could be implemented include ventilate improved pit (VIP) latrines, pond systems (anaerobic and oxidation ponds), and reed bed systems. Examples of resource utilization that could be implemented include composting of sludge or the selective enrichment of sludge with phosphate and nitrogen for use as fertilizer. Perhaps the ultimate approach would be the utilization of sewage nutrients to produce useful proteinaceous matter (algae, zooplankton or fish). To date, this approach has not been successful in producing cheap protein, but with the steadily rising cost of proteins, it may be viable in the long term. The essential role of research and development in the practical realization of this strategy is stressed. (Friedmann-PTT)
W90-01403

**AQUATIC HUMIC SUBSTANCES: INFLUENCE ON FATE AND TREATMENT OF POLLUTANTS.**
For primary bibliographic entry see Field 5B.
W90-01491

**INTERACTIONS OF HAZARDOUS-WASTE CHEMICALS WITH HUMIC SUBSTANCES.**
Missouri Univ., Columbia. Dept. of Chemistry.
For primary bibliographic entry see Field 5B.
W90-01497

**EFFECTS OF HUMIC BACKGROUND ON GRANULAR ACTIVATED CARBON TREATMENT EFFICIENCY.**
Michigan Univ., Ann Arbor. Dept. of Environmental and Water Resources Engineering.
For primary bibliographic entry see Field 5F.
W90-01521

**ADSORPTION OF MICROPOLLUTANTS ON ACTIVATED CARBON.**
University of Southern California, Los Angeles. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5F.
W90-01523

**DISSOLVED ORGANIC COMPONENTS IN PROCESS WATER AT THE LOS BANOS DESALTING FACILITY.**
California Univ., Los Angeles. School of Engineering and Applied Science.
J. Glater, L. C. Wilson, and J. B. Neethling.
IN: Aquatic Humic Substances: Influence on Fate and Treatment of Pollutants. American Chemical Society, Washington, DC. 1989. p 783-796, 7 fig, 1 tab, 15 ref.

Descriptors: *Wastewater renovation, *Water reuse, *Reverse osmosis, *Desalination, *Membrane processes, *Humic acids, *Agricultural wastewater, Organic matter, Chromatography, Spectrometry, Organic compounds, Chlorination, Trihalomethanes, Filtration, Salinity.

Agricultural wastewater reclamation is under serious consideration in the California Central San Joaquin Valley. A reverse osmosis (RO) pilot plant at Los Banos was designed with an elaborate pretreatment system to protect membranes from foul-

ing and degradation. A surveillance was conducted of dissolved organic materials in process water throughout this plant. Samples were analyzed by gas chromatography-mass spectrometry (GC-MS) with standard extraction techniques. Untreated water contains a highly complex mixture of essentially nonvolatile organic substances. Following chlorination, the mixture increases in complexity and includes three trihalomethane (THM) fractions, CHCl2Br, CHClBr2, and CHBr3. Bromoform was present at the highest concentration and chloroform, if present, was below the GC detection limit. Dissolved organic concentrations declined progressively following clarification and filtration. RO membranes tested at Los Banos did not significantly reject THMs.. (See also W90-01491) (Author's abstract)
W90-01534

**USE OF REGRESSION TECHNIQUES TO ESTIMATE OVERFLOW FREQUENCIES FROM DAILY PRECIPITATION DATA.**
Royal Netherlands Meteorological Inst., De Bilt.
T. A. Buishand.
IN: Hydrological Processes and Water Management in Urban Areas. Proceedings of the International Symposium 24-29 April 1988, Duisburg, West Germany. International Hydrological Programme of UNESCO Publication, 1988. p 45-52, 2 fig, 3 tab, 4 ref.

Descriptors: *Rainfall-runoff relationships, *Regression analysis, *Urban hydrology, *Sewer systems, *Overflow, *Precipitation, Mathematical analysis, Mathematical studies, Mathematical models, The Netherlands.

The probability of an overflow is related to the daily amount of precipitation. A regression model based on this probabilistic relation is used to derive annual overflow frequencies from daily precipitation data, and applied to quantify regional differences in mean overflow frequencies in The Netherlands. In the study in this paper, only the daily amount of precipitation was considered as an explanatory variable. The theory can easily be extended to situations with several explanatory variables. In situations where overflow events extend over several days, the question arises as to which day the event has to be assigned. To circumvent this question the annual overflow frequency is considered instead of the overflow events on individual days. The prediction error of the regression model gives an uncertainty of the same magnitude as the relative differences. (See also W90-01612) (Lantz-PTT)
W90-01617

**MODERNIZATION AND DEVELOPMENT OF SEWERAGE AND DRAINAGE SYSTEMS OF WARSAW AND CRACOW AGGLOMERATIONS.**
Institute of Environmental Protection, Warsaw (Poland).
P. Blaszczyk, and A. Nowakowska-Blaszczyk.
IN: Hydrological Processes and Water Management in Urban Areas. Proceedings of the International Symposium 24-29 April 1988, Duisburg, West Germany. International Hydrological Programme of UNESCO Publication, 1988. p 1197-204, 2 fig, 2 tab.

Descriptors: *Management planning, *Drainage systems, *Sewers, *Wastewater treatment, Costs, Crakow, Poland, Policy making, Costs, Economic aspects.

The location of wastewater treatment plants for the development of big towns and town agglomerations is a problem in Poland because of the overloadings of the existing systems and difficulties with new conveyance schemes in the old downtown areas. As a result of analyses being carried on in Poland it is considered necessary to decentralize wastewater treatment. The costs of sewage conveyance and the development of advanced wastewater treatment technologies are the main reasons for this viewpoint. (See also W90-01612) (Lantz-PTT)
W90-01634

**TRANSPORT OF SUSPENDED SOLIDS IN SEWERS.**
Witteveen and Bos, Deventer (Netherlands).
F. H. L. R. Clemens.
IN: Hydrological Processes and Water Management in Urban Areas. Proceedings of the International Symposium 24-29 April 1988, Duisburg, West Germany. International Hydrological Programme of UNESCO Publication, 1988. p 213-221, 4 fig, 7 ref.

Descriptors: *Sediment transport, *Storm runoff, *Urban runoff, *Water pollution sources, *Suspended solids, *Sewers, *Rainfall-runoff relationships, Storm water, Settleable solids, Flow discharge, Sludge, Path of pollutants.

Heavy rainfall often results in storm water overflows causing adverse effects on the quality of the receiving waters. In order to minimize these adverse effects, a number of measures can be taken, such as the application of special devices in the sewer system to reduce the pollution load, or swirl concentrators or settling tanks. Optimum design of these devices requires knowledge of the relation between quantity and quality of the storm water discharge. Information is needed on the transport of settled sludge which is brought into suspension in the sewers during storm flow conditions; the discharge of this sludge is the main source of pollution during overflows. (Author's abstract)
W90-01636

**TOWARDS COMPLETE INTEGRATION OF WATER QUALITY ASPECTS IN URBAN WATER MANAGEMENT DESIGN.**
Witteveen and Bos, Deventer (Netherlands).
J. G. A. Coppeps, and L. Vos.
IN: Hydrological Processes and Water Management in Urban Areas. Proceedings of the International Symposium 24-29 April 1988, Duisburg, West Germany. International Hydrological Programme of UNESCO Publication, 1988. p 223-230, 2 fig, 1 tab, 2 ref.

Descriptors: *Urban hydrology, *Wastewater treatment, *Water pollution control, *Water quality management, *Management planning, Computer models, Rainfall-runoff relationships, Storm water, Sewers, Overflow, Urban water, The Netherlands, Water management, Pollution load.

Computer modeling of non-permanent flow in storm water and sewer systems results in a more accurate description of the hydraulic processes. This often leads to considerable cost savings on construction or renovation of urban water management systems. Moreover, incorporating water quality modeling of processes such as deposition, mixing, mineralization and resuspension, gives insight into the frequency of exceedance of surface water pollution loads for each combined sewer overflow. With this information, more effective surface water pollution abatement measures can be taken. Experiments are being carried out with some special overflow devices, of which the swirl concentrator is a promising technique. This integrated approach of urban water management design has led to cost savings of 20%-40% for sewer systems in towns such as Breda, Deventer and Emmen. (See also W90-01612) (Lantz-PTT)
W90-01637

**URBAN DRAINAGE IN PARAMARIBO, SURINAME.**
Ministry of Public Works, Telecommunications and Construction, Paramaribo (Surinam).
H. Ehrenburg, and M. A. Meyer.
IN: Hydrological Processes and Water Management in Urban Areas. Proceedings of the International Symposium 24-29 April 1988, Duisburg, West Germany. International Hydrological Programme of UNESCO Publication, 1988. p 239-246, 3 fig, 1 tab.

Descriptors: *Urban hydrology, *Suriname, *Urban drainage, *Paramaribo, *Rainfall-runoff relationships, *Water management, Suriname, Storm water, Management planning, Water storage, Water transport, Costs, Drainage systems.

Paramaribo has grown rapidly during the last decades. As a consequence, urban rainfall discharge and sewage flows have increased. Studies have been conducted about how to reduce the problems of flooding and deteriorating environmental conditions. These studies have indicated that separate rain drainage and sewage systems will have to be constructed. In the ultimate situation, wastewater would be disposed of solely through closed pipes. Combining these with closed conduits for the discharge of excess rain water would mean problems with the settlement of sludge during dry periods, and extremely high costs because of the large discharge and storage capacities needed. To dispose of wastewater through a system of closed sewers of limited diameter, and to discharge excess rainwater by way of a system of open trenches and channels, would be less expensive. The wastewater would be conveyed to appropriate treatment facilities (such as anaerobic reactors or waste stabilization ponds), while the storm drainage system is provided with an adequate storage capacity. For this purpose, the construction of retention basins should be planned in areas with insufficient discharge capacity. (See also W90-01612) (Lantz-PTT)
W90-01639

**MANAGERIAL ASPECTS OF THE DESIGN AND OPERATION OF MODERN URBAN SEWAGE SYSTEMS.**
Rotterdam Public Works Dept. (Netherlands).
H. W. Hissink, and L. J. Pieterse.
IN: Hydrological Processes and Water Management in Urban Areas. Proceedings of the International Symposium 24-29 April 1988, Duisburg, West Germany. International Hydrological Programme of UNESCO Publication, 1988. p 269-282, 5 fig.

Descriptors: *Urban drainage, *Water management, *Wastewater management, *Wastewater treatment, Rotterdam, The Netherlands, Costs, Water treatment facilities.

In 1970, a law was passed in The Netherlands that forbids further drainage of untreated wastewater in open waters. As a result, two large wastewater treatment plants were built for Rotterdam. This made it necessary for the city to adapt its sewage system, more especially the main pumping stations, in order to transport the collected water to the new delivery points. During this reconstruction project, that amounts to an investment of 230 million Dutch guilders, the opportunity was seized to add a very modern computerized, real-time, monitoring and control system that automatically runs the various pumping stations with accessories to prevent the treatment plants from innundations. The arguments leading to the decision for the realization of such a system, the subsequent planning and some of the technical organization and social aspects, are discussed. (See also W90-01612) (Author's abstract)
W90-01642

**INTEGRATED MEASURES FOR THE REDUCTION OF STORM WATER AND COMBINED SEWER OVERFLOW IMPACT ON AN URBAN LAKE.**
Aalborg Universitetscenter (Denmark). Environmental Engineering Lab.
For primary bibliographic entry see Field 5G.
W90-01643

**EVALUATION OF THE REAL TIME CONTROL SYSTEM FOR THE WATER COLLECTION AND TREATMENT SYSTEM IN WEST-FRIESLAND.**
Technische Hogeschool Delft (Netherlands).
A. J. M. Nelen, F. H. M. Van de Ven, H. J. G. Hartong, and R. W. G. M. Melis.
IN: Hydrological Processes and Water Management in Urban Areas. Proceedings of the International Symposium 24-29 April 1988, Duisburg, West Germany. International Hydrological Programme of UNESCO Publication, 1988. p 303-310, 3 fig, 2 ref.

Descriptors: *Wastewater treatment, *Wastewater facilities, *Westfriesland, *The Netherlands, Pumps, Rainfall, Sewers, Water storage, Hydraulic machinery, Computer models, Simulation analysis.

In designing a regional treatment plant, the common procedure is to set its hydraulic capacity equal to the sum of the installed pump capacities of the contributing sewer systems. A reduction of the hydraulic capacity of the regional treatment plant Wervershoof in the Netherlands is possible, making optimal use of space-time variations of rainfall and the available storage in the combined sewer systems. A real time control system for the pumps of the contributing sewer systems has been in operation since 1983. This paper describes the situation in Westfriesland and discusses the first results of an evaluation of the control system in progress. The control system incorporates sufficient instruments to maximize the use of spatial variations in rainfall and the available storage in the sewer system. The allowable reduction, does not lead to an increase of the number of overflows, as determined by an analysis of recorded data and simulations with a computer model. This study emphasizes the necessity for proper data collection and regular evaluation, to get optimal operation and management of the sewerage system. (See also W90-01612) (Lantz-PTT)
W90-01645

**IRRATIONALITY IN DECISION MAKING PROCESS EXEMPLIFIED BY APPLIED POLICIES CONCERNING STORMWATER DETENTION IN DIFFERENT COUNTRIES.**
Lund Univ. (Sweden). Dept. of Water Resources Engineering.
For primary bibliographic entry see Field 6A.
W90-01646

**EFFICIENCY OF STORM WATER SEDIMENTATION TANKS INCORPORATED IN DUTCH SEWERAGE SYSTEMS.**
DHV Consulting Engineers, Amersfoort (Netherlands).
G. Onderdelinden, and J. L. Timmer.
IN: Hydrological Processes and Water Management in Urban Areas. Proceedings of the International Symposium 24-29 April 1988, Duisburg, West Germany. International Hydrological Programme of UNESCO Publication, 1988. p 317-325, 2 fig, 3 tab, 9 ref.

Descriptors: *Urban runoff, *Storm water, *Sedimentation, *Drainage systems, *Water quality, *The Netherlands, Monitoring, Chemical oxygen demand, Suspended solids, Biochemical oxygen demand, Phosphorus, Nitrogen.

Since 1983, an extensive research program on the relation between sewerage systems and surface water quality has been carried out in The Netherlands. One of the research projects was to determine the efficiency of storm water sedimentation tanks. Investigations were carried out in the towns of Amersfoort and Kerkrade. To quantify the pollution emission, a monitoring program was set up to measure the flow, duration and pollution of storm water discharges. The measuring apparatus was placed near the inflow and outflow devices where it continually registered water levels. During operation of the tank, samples of the inflowing and outflowing storm water were taken automatically. These samples were analyzed for various chemical and physical parameters. The monitoring program was carried out from 1982 to 1985. The results for both tanks showed an overall chemical oxygen demand (COD) efficiency of 65%. The overall efficiency of the dry residue of undissolved solids amounted to 65%. The biochemical oxygen demand (BOD) was more or less equivalent to the COD efficiency. The efficiency of P-total and N-Kjeldahl removal was less than that for COD. (See also W90-01612) (Author's abstract)
W90-01647

**EFFECT OF UTILIZATION OF GEOTHERMAL WATERS ON THE DISCHARGE AND TREATMENT OF MUNICIPAL WASTE WATERS.**
Vyskumny Ustav Vodohospodarsky, Bratislava (Czechoslovakia).
J. Pobis.
IN: Hydrological Processes and Water Management in Urban Areas. Proceedings of the International Symposium 24-29 April 1988, Duisburg, West Germany. International Hydrological Programme of UNESCO Publication, 1988. p 327-333, 2 fig, 3 tab, 4 ref.

Descriptors: *Wastewater treatment, *Municipal wastewater, *Thermal water, Geothermal resources, Activated sludge, Microorganisms, Activated sludge process.

Following the thermal energy use of geothermal waters for residential needs, those waters become wastewaters which have to conveyed to a receiving water body. The problem then arises about whether it is admissible to discharge the highly mineralized waters into the municipal sewerage system. Consideration has to be given to the possibly unfavorable effects of the disposal, and inhibition of the wastewater treatment process. The Water Research Institute in Bratislava, Czechoslovakia, has performed an experimental study with two types of thermal waters (HCO3-Cl-Na, Cl-Na) to assess their effect on anaerobic biological treatment using activated sludge. Gradual adaptation of the activated sludge has confirmed that the treatment of municipal wastewaters following their mixing with thermal water, may proceed a limiting ratio of thermal to municipal wastewaters, without disturbing the treatment efficiency. This ratio for thermal waters of the type Cl-HCO3-Na is 1:3, and for Cl-Na type water is 1:2 (eventually becoming 1:1). The activated sludge efficiency according to biochemical oxygen demand (BOD) continues to be high. The biota of the activated sludge is characteristic of this kind of treatment of municipal wastewaters showing a normal acclimatization of microorganisms. After the limiting ratio is exceeded, intensive increases in filamentous organisms occur with an accompanying deterioration of sludge settling characteristics. The investigated thermal waters may be discharged into the municipal sewerage system only if the limiting ratios of thermal to municipal wastewater are maintained. (See also W90-01612) (Author's abstract)
W90-01648

**RECENT TRENDS IN THE REAL TIME CONTROL OF URBAN DRAINAGE SYSTEMS.**
Hanover Univ. (Germany, F.R.). Inst. fuer Grundbau, Bodenmechanik und Energiewasserbau.
W. Schilling.
IN: Hydrological Processes and Water Management in Urban Areas. Proceedings of the International Symposium 24-29 April 1988, Duisburg, West Germany. International Hydrological Programme of UNESCO Publication, 1988. p 335-342.

Descriptors: *Urban drainage, *Drainage systems, *Water pollution control, *Urban runoff, *Process control, Hydraulic structures, Rain gages, Weirs, Dams, Pumps.

Real time control (RTC) of urban drainage systems (UDS) offers a potential way to reduce the pollution problems of combined sewer overflows with relatively little investment cost. Apart from pollution abatement RTC can create side-benefits such as less flooding, improved wastewater treatment, in-sewer sediment control, and supervision, understanding, and record keeping of systems performance. A large variety of UDS are controlled in real time. The market offers few proven hardware elements to sufficiently equip reliable RTC systems. Typically systems include: conventional point rain gages and water level sensors; pumps, gates, weirs, inflatable dams, and other regulators; leased telephone line telemetry; and a distributed digital control system with on-site microprocessors and dual central minicomputers. Control concepts can be as simple as mere local control with or without central supervision, or as advanced as optimized systems control. Most of the existing systems allow for advanced control concepts, but are only operated in local control. (See also W90-01612) (Author's abstract)
W90-01649

**COMBINED SEWER OVERFLOW ABATEMENT BY ON-SITE DETENTION, INFILTRATION, AND RE-USE.**
Hanover Univ. (Germany, F.R.). Inst. fuer Grundbau, Bodenmechanik und Energiewasserbau.
W. Schilling, J. Lenz, and U. Rieger.
IN: Hydrological Processes and Water Management in Urban Areas. Proceedings of the International Symposium 24-29 April 1988, Duisburg, West Germany. International Hydrological Programme of UNESCO Publication, 1988. p 343-350, 5 fig, 1 tab.

Descriptors: *Combined sewer overflows, *Water pollution control, *Urban drainage, *Infiltration, *Urban runoff, Water storage, Runoff, Catchment basins, Rainfall-runoff relationships, Flood peak.

One of the major water pollution problems in urban areas is that of combined sewer overflows (CSO). Through application of best management techniques (BMP) it is intended to reduce runoff or pollution at their sources, thereby also reduce CSO. Here, the efficiency of roof runoff on-site detention, infiltration and re-use for toilet flushing is evaluated with respect to reduction of peak runoff and runoff volume. These measures are particularly applicable if the roof area is a large percentage of the total impervious area. For four urban catchments, the rainfall-runoff process was continuously simulated over a period of eleven years. Peak flow and volume reductions up to 70% of the catchment runoff were found to be achievable. In case of roof runoff re-use for toilet flushing, up to 90% of the drinking water can be saved that would be used otherwise. The efficiency of on-site runoff reduction was extrapolated for city-wide application to estimate gross combined sewer overflow reduction. (See also W90-01612) (Author's abstract)
W90-01650

**AREA RETENTION USED AS AN ELEMENT FOR THE DESIGN OF URBAN CATCHMENTS.**
Ingenieurburo fuer Wasserwirtschaft, Dreieich, West Germany.
For primary bibliographic entry see Field 4A.
W90-01652

**REVIEW OF PROGRAM 'URBAN HYDROLOGICAL R AND D IN NORWAY 1983-1987'.**
Norges Vassdrags- og Elektrisitetsvesen, Oslo.
R. Skretteberg.
IN: Hydrological Processes and Water Management in Urban Areas. Proceedings of the International Symposium 24-29 April 1988, Duisburg, West Germany. International Hydrological Programme of UNESCO Publication, 1988. p 365-372, 5 fig, 1 tab.

Descriptors: *Urban hydrology, *Norway, *Evaluation, *Hydrologic budget, *Water management, Management planning, Research priorities, Surface runoff, Rainfall-runoff relationships, Snowmelt, Infiltration, Groundwater recharge.

A five year urban hydrological Research and Development program has just been finalized in Norway. The program was initiated and administered by the Urban Hydrological Working Group of the Norwegian Hydrological Committee. Although no elements of the urban hydrological cycle were excluded from the program, special emphasis was put on rainfall distribution in urban areas, surface runoff, regional runoff distribution, problems involving snow melt and infiltration and local storm water disposal under Norwegian conditions. (See also W90-01612) (Author's abstract)
W90-01653

**CONCEPTS OF URBAN DRAINAGE AND FLOOD PROTECTION ADOPTED FOR THE CITY OF TOKYO.**
Shibaura Inst. of Tech., Tokyo (Japan).
For primary bibliographic entry see Field 4A.
W90-01654

**RAPID REMOVAL OF WATER: A DANGER FOR ALL BODIES OF WATER.**
Emschergenossenschaft und Lippeverband, Essen (Germany, F.R.).
For primary bibliographic entry see Field 5B.
W90-01672

**METHODS OF REDUCING THE STORM SEWAGE OVERFLOWS.**
TAUW Infra Consult B.V., Deventer (Netherlands).
For primary bibliographic entry see Field 4A.
W90-01678

**STRATEGIES IN URBAN WATER DESIGN.**
Technische Hogeschool Delft (Netherlands). Dept. of Architecture and Urban Regional Planning.
For primary bibliographic entry see Field 6A.
W90-01701

**CO-TREATMENT OF MANUFACTURED GAS PLANT SITE GROUNDWATERS WITH MUNICIPAL WASTEWATERS.**
Gas Research Inst., Chicago, IL.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-115240. Price codes: A10 in paper copy, A01 in microfiche. Report No. GRI-88/0218, August 1988. 211p, 14 fig, 27 tab, 54 ref, 4 append. Gas Research Institute Contract 5086-254-1350.

Descriptors: *Water pollution treatment, *Water treatment, *Groundwater quality, *Wastewater treatment, *Municipal wastewater, *Activated sludge process, Inorganic carbon, Nitrogen compounds, Volatile organic compounds, Metals, Phenols, Organic compounds, Polycyclic aromatic hydrocarbons.

A pilot-scale treatability study was performed to evaluate the capability to effectively treat Manufactured Gas Plant (MGP) site waters, for example pumped groundwaters, with municipal wastewaters at Publicly Owned Treatment Works (POTW) which employ activated sludge biological treatment. The study was performed as part of an overall program evaluating various remediation technologies for restoration of MGP sites. Data from the study supports the contention that MGP site groundwaters can be effectively co-treated with municipal wastewaters in POTW activated sludge facilities. MGP site groundwaters containing chemicals-of-interest (i.e. organics, metals, volatile aromatics, phenolics, and polynuclear aromatic hydrocarbons) and conventional pollutants added to POTW wastewaters should result in no measurable effect on POTW activated sludge treatment plant operations, waste activated sludge quality, or treated effluent quality. This is due in part to the fact that MGP site groundwaters will generally only make up a relatively small percentage (< 0.1% to 5%) of the total influent flow to a POTW under a normally anticipated co-treatment scenario. Under such a scenario, MGP site chemicals-of-interest in a POTW influent (comprised of MGP site water and municipal wastewater) should be near or below detectable concentration levels with associated low or below detectable respective mass loadings. Under this co-treatment scenario, no effects was measured in terms of activated sludge reactor operation and treated effluent quality for conventional pollutant parameters. In terms of chemicals-of-interest, reactor mass balance results showed the following: (1) inorganics--ammonia nitrogen was nitrified to nitrate and 66% of the total cyanide was biodegraded; (2) metals--generally the metals passed through the activated sludge process with some adsorption onto the sludge; (3) volatile aromatics--the majority of the volatile aromatics were biodegraded with minor volatilization; (4) phenolics--> 97% of the phenolics were biodegraded with minor adsorption; and (6) polynuclear aromatic hydrocarbons (PAH)--in general, the data generated demonstrates that PAHs added to an activated sludge process below their respective solubility limits will result in > 99% biodegradation with no measurable adsorption. (Lantz-PTT)
W90-01702

**SUPERFUND RECORD OF DECISION: ZELLWOOD, FL.**
Environmental Protection Agency, Washington, DC. Office of Emergency and Remedial Response.
For primary bibliographic entry see Field 5G.
W90-01703

**STATUS REPORT FOR THE HANNA AND HOE CREEK UNDERGROUND COAL GASIFICATION TEST SITES.**
University of Wyoming Research Corp., Laramie. Western Research Inst.
For primary bibliographic entry see Field 5G.
W90-01711

**SUPERFUND RECORD OF DECISION: AMERICAN THERMOSTAT, NY.**
Environmental Protection Agency, Washington, DC. Office of Emergency and Remedial Response.
For primary bibliographic entry see Field 5G.
W90-01712

**SUPERFUND RECORD OF DECISION: YORK OIL COMPANY, NY.**
Environmental Protection Agency, Washington, DC. Office of Emergency and Remedial Response.
For primary bibliographic entry see Field 5G.
W90-01714

**SUPERFUND RECORD OF DECISION: KEEFE ENVIRONMENT, NH.**
Environmental Protection Agency, Washington, DC. Office of Emergency and Remedial Response.
For primary bibliographic entry see Field 5G.
W90-01715

**SUPERFUND RECORD OF DECISION: EAU CLAIRE MUNICIPAL WELL, WI.**
Environmental Protection Agency, Washington, DC. Office of Emergency and Remedial Response.
For primary bibliographic entry see Field 5G.
W90-01717

**SUPERFUND RECORD OF DECISION: L.A. CLARKE AND SON, VA.**
Environmental Protection Agency, Washington, DC. Office of Emergency and Remedial Response.
For primary bibliographic entry see Field 5G.
W90-01718

**DESIGN CRITERIA FOR PROCESS WASTEWATER PRETREATMENT FACILITIES.**
Air Force Occupational and Environmental Health Lab., Brooks AFB, TX.
A. H. Riojas, and R. D. Binovi.
Available from the National Technical Information Service, Springfield, VA 22161, as AD-A198 868. Price codes: A06 in paper copy, A01 in microfiche. USAFOEHL Report 88-069EQ0111EIB, May 1988. Final Report. 119p, 1 fig, 20 tab, 66 ref, 10 append.

Descriptors: *Design standards, *Wastewater treatment, *Pretreatment of water, Process water, Filtration, Flotation, Chemical treatment, Chlorination, Ozonation, Ion exchange, Granular activated carbon, Adsorption, Physical separation, Sedimentation, Anaerobic digestion, Activated sludge process, Volatilization, Trickling filters.

Many industrial wastewater streams can be discharged into Publicly Owned Treatment Works (POTW); however, they must meet prescribed characteristics, and concentrations of specific contaminants must not be exceeded. Wastewater sources on Air Force bases and the corresponding wastewater characteristics are described, applicable discharge limits are reviewed, and typical pretreatment process sequences which would be effective in brining these wastewater streams into compliance with the relevant discharge limits are given for the wastewater classes identified in the report. A description of wastewater treatment processes is included, and design equations and procedures for the processes are provided in the appendices. The treatment process alternatives discussed include: gas flotation; filtration; sedimentation/coagulation; chlorination; ozonation; granular activated carbon adsorption; ion exchange; aerated lagoons/activated sludge/ AS-PAC; anaerobic digestion; trickling filters; microfiltration, ultrafiltration, and reverse osmosis; oil/water separation; air stripping; and chemical reduction. (Lantz-PTT)
W90-01719

**CLOSURE PLAN FOR THE DECOMMISSIONED HIGH EXPLOSIVES RINSE-WATER LAGOONS AT LAWRENCE LIVERMORE NATIONAL LABORATORY SITE 300.**
Lawrence Livermore National Lab., CA. Environmental Restoration Div.
For primary bibliographic entry see Field 5G.
W90-01723

**GRANULATION IN UPFLOW ANAEROBIC SLUDGE BLANKET REACTOR (IN JAPANESE).**
T. Hoaki, T. Tomozawa, and S. Kaneko.
In: Taisei Technical Research Report 20. p 27-34, 19 fig, 5 tab, 7 ref. English summary.

Descriptors: *Anaerobic digestion, *Sludge conditioning, *Methane bacteria, Fermentation, Settling properties, Methane, Separation.

Upflow Anaerobic Sludge Blanket (UASB) reactors were studied and to evaluate a methane fermentation process for the treatment of wastewater. The essential feature of the UASB process is high activity of anaerobic bacterial mass in the reactor which forms granular sludge. This system has a higher specific loading rate and superior settling properties of granular sludge. The results are summarized as follows: (1) The granular sludge was obtained after 60 days, and the total organic carbon reduction rate was 85%. The volume of methane gas produced was 18L CH4/day (2.5L-CH4/L/day) at a specific loading rate of 3.85 g-c/L/day at 35 C; (2) The Ca(2+) and Mg(2+) content of the wastewater did not directly affect granulation from seed sludge and sedimentation of sludge after granulation; (3) Some acid producing bacteria gathered inside the granular sludge, and the methane producing bacteria, Methanothrix soehngenii, covered the surface of granular sludge; and (4) After enzyme treatment, granular sludge remained with the bacteria, though the polymer of the extracellular was separated. (Author's abstract)
W90-01734

**PSYCHROPHILIC BIOFILM REACTORS FOR ANAEROBIC DIGESTION (PSYKROFILE BIOFILMREAKTORER TIL ANAEROB UDRADNING).**
F. H. Spendler.
Available from National Technical Information Service, Springfield, VA 22161 as DE88750389/GAR, Price codes: A04 in paper copy, A01 in microfiche. Report NEI-DK-50. April 1987. 56p, 13 fig, 12 tab, 8 ref, append. English summary.

Descriptors: *Wastewater treatment, *Anaerobic digestion, *Biofilm reactors, *Methane, Chemical oxygen demand, Temperature, Organic loading.

Three identical fixed-bed anaerobic reactors (10 L void volume) were used to digest whey permeate at 12 C, 20 C and 35 C. The organic load was kept constant at 7 g COD/L/reactor/day in 90 days 'Steady state' operation. The overall COD-reduction at 12 C was near 80% of the COD-reduction at 35 C. At 20 C the COD-reduction was 88% of the COD-reduction at 35 C. The COD-reduction versus temperature shows a straight line. On the other hand, the specific gas production (l methane/g COD added), versus temperature, was not a straight line. This could be explained by the fact that the solubility of gas increases with decreasing temperature. At 12 C the specific methane production was 55% of the production at 35 C. At 20 C the specific methane production was 70% of the production at 35 C. These results indicate that it is possible to treat 'cold waste water' at a low temperature with nearly the same COD-reduction as

with 35 C if the liquid retention time is increased, probably 20-25%. (Author's abstract)
W90-01740

**GASSING OF BIOSUSPENSIONS IN BUBBLE COLUMN AND LOOP REACTORS (BEGASUNG VON BIOSUSPENSIONEN IN BLASENSAULEN UND SCHLAUFENREAKTOREN).**
Stuttgart Univ. (Germany, F.R.). Fakultaet 13 - Verfahrenstechnik.
G. Mueller.
Available from National Technical Information Service, Springfield, VA 22161 as DE88770020/GAR, Price codes: A07 in paper copy, A01 in microfiche. Report NP-8770020. April 1986. 131p, 57 fig, 1 tab, 82 ref, 12 append. In German.

Descriptors: *Wastewater treatment, *Biological wastewater treatment, *Aeration, *Aerators, Reactors, Mass transfer coefficients, Gas/liquid transport, Mathematical models.

In the aereation tanks of biological waste water purification plants, oxygen is consumed in the aerobic metabolism of microorganisms. As a rule, oxygen is supplied by gassing the sludge/water suspension with air. The parameters determining the gas/liquid transport, i.e. the void gas velocity, bubble size and bubble distribution, were determined using a specific mass transfer coefficient. The coefficient is determined, for the most part, by the aereator characteristics and by the coalescence behavior of the water/sludge suspension. The influence of these parameters on the optimum reactor height under energy aspects is shown using mathematical models. The findings suggest that the optimum reactor height is not constant but depends on the aereator parameters, the water coalescence characteristics, and the remixing of the liquid phase. (Author's abstract)
W90-01742

**REPORT 1986 (BERICHT 1986).**
Technische Univ. Hamburg-Harburg (Germany, F.R.). Arbeitsbereich Gewaesserreinigungstechnik.
U. Foerstner, I. Sekoulov, R. Stegmann, and P. A. Wilderer.
Available from National Technical Information Service, Springfield, VA 22161 as DE87753274/GAR, Price codes: A04 in paper copy, A01 in microfiche. Report NP-7753274. February 1987. 65p, 11 fig, 45 ref, append. English summary.

Descriptors: *Wastewater treatment, *Landfills, *Solid waste disposal, Aerobic treatment, Biological treatment.

Current research projects of Hamburg-Harburg Technical University in the fields of water purification and environmental protection are reviewed. Wastewater treatment studies include bio-aeration and gassing, filtration, phosphate elimination, and heavy metal concentration measurements. In the field of environmental protection, the main activities were in refuse diposal and landfill management. (Author's abstract)
W90-01746

**COMPARATIVE ODOR MEASUREMENTS IN WASTE WATER TREATMENT PLANTS (VERGLEICHENDE GERUCHSMESSUNGEN AUF ABWASSERREINIGUNGSANLAGEN).**
K. Kaiser, and H. Teichmann.
Available from National Technical Information Service, Springfield, VA 22161 as TIB/B87-81495/GAR, Price codes: E11 in paper copy. Report 24/1987. 1987. 134p, 33 fig, 60 tab, 46 ref, append. In German.

Descriptors: *Instrumentation, *Wastewater treatment, *Odor control, *Odors, *Wastewater facilities, *Photo-ionization detectors.

The coordination of olfactometric odor measurements with physical/chemical methods in the area of the development of odors in sewage plants is the main point of a research report. The causes of odors were also examined. It was found that threshold values of odor, which could be used for deciding on the degree of obnoxiousness of odor emission are not possible at present, as they differ by powers of ten or certain odoriferous materials are not present in sewage plants. It is proposed to measure odors using photo-ionization detectors, as these can be used flexibly. These should be supplemented by olfactometric measurements, in order to produce correlations with the physical/chemical measurements. (Author's abstract)
W90-01748

**NATURAL SEWAGE TREATMENT PROCESSES FROM THE LANDSCAPE PLANNING POINT OF VIEW: POSSIBILITIES AND LIMITS (NATURNAHE KLAERVERFAHREN AUS LANDSCHAFTSPLANERLSCHER SICHT: MOEGLICHKEITEN UND GRENZEN).**
Technische Univ. Berlin (Germany, F.R.). Fachbereich 14 - Landschaftsentwicklung.
B. Gehrke, H. Haas, C. Lippert, and B. Prevot.
Available from National Technical Information Service, Springfield, VA 22161 as TIB/A87-81262/GAR, Price codes: E07 in paper copy. Report 42. 1986. 270 p, 74 fig, 25 tab, 121 ref. In German.

Descriptors: *Land disposal, *Wastewater treatment, *Wastewater facilities, *Self-purification, Technical aspects, Ecological aspects, Economic aspects, Political aspects.

By using natural removal processes, it is as possible that improvements in sewage treatment technique and therefore in the quality of water courses, could be obtained. The aim of this scientific work was to introduce, compare and assess different natural sewage treatment processes and to show their limits from the technical, ecological, economic and political aspects. A survey concerned with the development in dealing with waste water and with the change in the importance of water and the total load situation of the water courses was conducted. Data on laws, their effects and possibilities were also reviewed. Various plant sewage treatment processes are discussed (structure, position, application, performance) and several examples of applications in large cities are given. Plant sewage treatment systems are cheaper alternatives to conventional sewage treatment techniques, particularly for country areas and thinly settled areas. (Author's abstract)
W90-01749

**SOME LIPOPHILIC COMPOUNDS FORMED IN THE CHLORINATION OF PULP LIGNIN AND HUMIC ACIDS.**
Svenska Traeforskningsinstitutet, Stockholm.
For primary bibliographic entry see Field 5B.
W90-01760

**RESEARCH AND DEVELOPMENT IN WASTEWATER TECHNOLOGY AND IN PROTECTING WATER COURSES (FORSCHUNG UND ENTWICKLUNG IN DER ABWASSERTECHNIK UND BEIM GEWAESSERSCHUTZ-EINE STUDIE).**
Abwassertechnische Vereinigung e.V., St. Augustin (Germany, F.R.).
H. H. Hann, D. Albrecht, and I. Bantz.
Available from National Technical Information Service, Springfield, VA 22161 as TIB/A87-80484/GAR, Price codes: E07 in paper copy. 1986. 353p, 15 fig, 9 tab. In German.

Descriptors: *Wastewater treatment, *Water pollution control, *Water pollution treatment, *West Germany, Development, Economic aspects, Pretreatment, Self-purification, Biological wastewater treatment.

The engineering tasks of the inhabited areas water economy have become more numerous and more varied in order to protect the environment. A survey of this complex of problems starts with explanations of protecting water in West Germany (development, aims, previous efforts, financial aspects). The future tasks in research and development are then given. There is a report on protecting water courses, leading soil and groundwater, pretreatment and reduction of commercial and industrial wastewater, wastewater and rainwater drains, sewerage (design, construction reorganization), biological and natural as well as nonbiological processes for cleaning waste water and improving the performance of this process, treatment of slurry, emission and automation. There are notes on subjects which must be described as negative. A central control of research is not regarded as necessary, based on successful results for waste water technology and the protection of watercourses achieved so far. (Author's Abstract)
W90-01776

**NITRIFICATION IN PEBBLE BED REACTORS AND DENITRIFICATION IN PEBBLE BED REACTORS AND FLOATING BED REACTORS USING CARRIER MATERIAL AND ACTIVATED SLUDGE AS HYDROGEN DONATORS (NITRIFIKATION IN FESTBETTREAKTOREN UND DENITRIFIKATION IN FESTBETT-UND SCHWEBEBETTREAKTOREN UNTER VERWENDUNG VON TRAEGERMATERIAL UND BELEBTSCHLAMM ALS WASSERSTOFFDONATOREN).**
Stuttgart Univ. (Germany, F.R.). Sonderforschungsbereich 82 - Siedlungswasserbau und Wasserguetewirtschaft.
W. R. Mueller.
Available from National Technical Information Service, Springfield, VA 22161 as TIB/A87-80539/GAR, Price codes: E07 in paper copy. September, 1986. 365p, 19 fig, 5 tab, 24 ref, 17 append. In German.

Descriptors: *Wastewater treatment, *Nitrification, *Biological wastewater treatment, *Activated sludge process, Hydrogen donors, Sludge loading, Suspension bed reactor.

In this report in two parts, the use of carrier materials, which can be biologically decomposed, as hydrogen donors for denitrification is discussed. The present state of knowledge is described and experiments in which the filler and the growth body act as a source of carbon and hydrogen for denitrification in a solid bed are explained. The use of different natural granulated materials, plastics and compounds makes it possible to compare their advantages and disadvantages as carriers for the biofilm and as substrate reservoirs. The second part of the report is concerned with the intensification of denitrification by increasing the sludge loading with the same nitrification yield. Comparisons are made between the speeds of denitrification in a conventional activated sludge denitrification basin and a suspension bed reactor with carrier material to increase the biomass concentration. (Author's Abstract)
W90-01777

**SEDIMENTATION, THICKENING AND DEWATERING OF PRECIPITATION/FLOCCULATION SLURRIES (SEDIMENTATION, EINDICKUNG UND ENTWAESSERUNG VON FAELLUNGS-/FLOCKUNGSSCHLAEMMEN).**
Karlsruhe Univ. (Germany, F.R.). Inst. fuer Siedlungswasserwirtschaft.
V. Mertsch.
Available from National Technical Information Service, Springfield, VA 22161 as TIB/A88-80777/GAR, Price codes: E07 in paper copy. Contract 02 WS 857/156. Report 46, June 1986. 200p, 60 fig, 11 tab, 263 ref.

Descriptors: *Wastewater treatment, *Flocculation, *Sludge thickening, *Sludge drying, Chemical precipitation, Slurries, Sludge conditioning, Sludge lagoons.

A research project was undertaken to precisely characterize wastewater precipitation and flocculation. The investigations were carried out at a test plant in several settling basins, where iron and aluminum salts are used as flocculants. The investigations proved that the qualities of the precipitation-/flocculation slurries are decisively influenced by the flocculation conditions. The resulting sludge-solids yield can therefore be represented as a function of the precipitation-/flocculation average concentration. In contrast to the solids yield, other phases of slurry treatment (sedimentation,

thickening, and dewatering) were more influenced in kind and quantity by wastewater components present during the precipitation/flocculation stages. The settling behavior of the sediment-depositing suspensions and flocs was influenced in many ways by precipitation and flocculation. The investigation of settling-velocity distribution showed that in both preclarification (pre-precipitation/-flocculation) and post-precipitation/-flocculation a higher average settling velocity of individual particles and flakes occurs after the introduction of chemicals. With pre-precipitation and post-precipitation/flocculation an increasing chemicals dosage led to a disproportionately increasing sludge volume. The interpretation of the results of sedimentation, thickening, and dewatering investigations showed that the amount of chemical treatment before, during, and after slurry precipitation/flocculation influences not only the proportion of organic/inorganic components but also the degree of pH reduction. (Shidler-PTT)
W90-01785

**INVESTIGATIONS ON PHOSPHORUS REMOVAL FROM WASTE WATER BY PRECIPITATION OF CALCIUM PHOSPHATE INDUCED BY SEEDING CRYSTALS (UNTERSUCHUNGEN ZUR PHOSPHATENTFERNUNG AUS WASER DURCH ABSCHEIDUNG VON CALCIUMPHOSPHAT).**
Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Radiochemie.
J. A. Reiger.
Available from National Technical Information Service, Springfield, VA 22161 as TIB/B88-80941/GAR, Price codes: E14 in paper copy. Report KFK-4290, August 1987. 159p, 30 fig, 22 tab, 97 ref, 2 append. English summary.

Descriptors: *Wastewater treatment, *Separation techniques, *Phosphorus removal, Precipitation, Calcite, Iron salts, Tricalcium phosphate, Carbonates, Magnesium, Calcium phosphate.

Apart from phosphorus, community wastewater also contains calcium. If chemical equilibrium is to be set up, most of the phosphorus must be precipitated in the sewage plant. A research project was to achieve elimination of phosphorus from water by the separation of calcium phosphate induced by seeding crystals. Experiments were carried out in beakers and in flow experiments. The effects of apatite, tricalcium phosphate, calcite and iron(III) salts were determined. It was found that the use of calcite as seeding material for the direct separation of calcium phosphate can be regarded as a promising possibility for the elimination of phosphorus from waste water. The separation of phosphorus by carbonate and magnesium ions in the water is not prevented by this. Compared to precipitation with iron (III) salts, this process has the advantage that there is no salt concentration, so only small quantities of lime are needed. An easily usable calcium phosphate product is obtained instead of precipitation slurry. (Author's Abstract)
W90-01786

**INVESTIGATIONS OF ANAEROBIC DEGRADATION OF WASTE WATER FROM CHEMICAL PROCESSES IN INDUSTRIAL SEWAGE TREATMENT PLANTS (UNTERSUCHUNGEN ZUM ANAEROBEN ABBAU CHEMISCHER PROZESSABWASSER IN KOMMUNALEN KLARANLAGEN).**
Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.).
J. Schelchshorn, and D. Blank.
Available from National Technical Information Service, Springfield, VA 22161 as DE88770092/GAR, Price codes: A07 in paper copy, A01 in microfiche. Report NP-8770092, February 1987. 135p, 46 fig, 10 tab, 21 ref.

Descriptors: *Wastewater treatment, *Anaerobic digestion, *Industrial wastes, *Industrial wastes, *Biological wastewater treatment, *Municipal wastewater, Filters, Sludge disposal, Biogas.

Two concepts for biological treatment of industrial wastewater were investigated. Concept 1 consisted of a joint anaerobic treatment of municipal sewage and industrial wastewater. Concept 2, in which the industrial wastewater was treated separately in an anaerobic activation process or by an anaerobic filter, intended to minimize the sludge volume to enable sludge disposal by combustion if necessary. Experiments were made on laboratory scale, pilot scale, and in the municipal sewage treatment plant of Abwasserverband Raumschaft Lahr (AV). The results showed: 1. Separate anaerobic treatment of industrial wastewater according to concept 2 is not feasible. 2. Joint anaerobic treatment of industrial wastewater and municipal sewage sludge according to concept 1 had excellent results with CSB and AOX degradation rates over 80%. The total biogas yield of the AV sewage treatment plant was higher by 65 to 80% with concept 1 than with concept 2. (Author's Abstract)
W90-01787

**MEASUREMENT OF THE ACTIVATION PROCESS BY ADDITIONAL MEASUREMENTS OF WASTE AIR COMPONENTS (ERFASSUNG DES BELEBUNGSPROZESSES DURCH ZUSAETZLICHE MESSUNG VON ABLUFTKOMPONENTEN).**
Stuttgart Univ. (Germany, F.R.). Inst. fuer Siedlungswasserbau, Wassergutewirtschaft und Abfalltechnik.
H. Steinecke, and D. Wappler.
Available from National Technical Information Service, Springfield, VA 22161 as TIB/A87-80501/GAR, Price codes: E07 in paper copy. Contract BMFT 02-WA 276 / BCT 0267 7. June 1985. 102p, 20 fig, 7 tab, 11 ref.

Descriptors: *Activated sludge process, *Monitoring, *Wastewater treatment, Waste air, Gas analyzers, Microprocessors, Carbon dioxide, Nitrogen, Carbon.

Using available measurement techniques, the processes occurring in activation in sewage treatment plants cannot be adequately measured. Investigations were therefore done with the aim of being able to find information on the activation process by analysis of the waste air. It was found that by measuring the waste air components of carbon dioxide, oxygen and di-nitrogen monoxide in forced draught sewage plants, one could obtain basic information on material change processes. The measuring system used (waste air collection device, measuring position changeover switch, 3 gas analyzers, microprocessor system for control, data collection, assessment and data recording) makes a quasi continuous, reliable measurement system requiring as little maintenance as possible in the individual sections of ponds. The carbon balance makes it possible to classify decomposition products in the waste air, drainage and excess slurry via TOC, TIC, and CO2 loads. (Author's Abstract)
W90-01788

**FLOW MEASUREMENT AT SEWAGE TREATMENT PLANTS.**
Vizgazdalkodasi Tudomanyos Kutato Intezet, Budapest (Hungary). Inst. for Hydraulic Engineering.
For primary bibliographic entry see Field 7B.
W90-01817

## 5E. Ultimate Disposal Of Wastes

**MODELING OF LEAKAGE THROUGH CRACKED CLAY LINERS--I: STATE OF THE ART.**
Wayne State Univ., Detroit, MI. Dept. of Civil Engineering.
C. J. Miller, and M. Mishra.
Water Resources Bulletin WARBAQ, Vol. 25, No. 3, p 551-556, June 1989. 39 ref.

Descriptors: *Water pollution sources, *Liners, *Clay liners, *Landfills, *Leakage, Groundwater pollution, Model studies, Pores.

The existence and importance of macro-pores to the containment efficiency of cover clay liners at waste landfills is documented. Macro-pores exist as voids, or cracks, and act to increase the volume and rate of leakage through cover liners. Existing numerical models used to simulate flow through clay liners are shown to neglect the macro-pore aspect of the problem. Current theories of macro-pore flow developed from related areas of research are presented, and applications to the landfill liner problem are considered. (Author's abstract) (See also W90-00970)
W90-00969

**MODELING OF LEAKAGE THROUGH CRACKED CLAY LINERS--II: A NEW PERSPECTIVE.**
Wayne State Univ., Detroit, MI. Dept. of Civil Engineering.
C. J. Miller, and M. Mishra.
Water Resources Bulletin WARBAQ, Vol. 25, No. 3, p 557-563, June 1989. 4 fig, 2 photo, 6 ref.

Descriptors: *Liners, *Water pollution sources, *Clay liners, *Landfills, *Leakage, Groundwater pollution, Model studies, Pores, Darcys law.

A hydraulic description of moisture transport through the compacted clay layers of a landfill cover liner is present. Previous descriptions have assumed that micro-pore processes control the transport. The present description incorporates the influence of voids or macro-pores created by desiccation cracking. The existence and importance of cracks is documented using laboratory and field data. Although micro-pore flow can be modeled confidently using Darcy's Law, the contribution of macro-pore flow is often neglected because of the lack of field verified models to describe it occurrence. The variety of modes and mechanisms of flow that are operative in flow through cracked clay liners is discussed, and analogies are made to familiar concepts in open channel flow theory. The discussion provides the conceptual framework for development of a numerical model to simulate both micro-pore and macro-pore flow phenomena. (Author's abstract) (See also W90-00969)
W90-00970

**INFILTRATION, SOIL MOISTURE, AND RELATED MEASUREMENTS AT A LANDFILL WITH A FRACTURED COVER, ILLINOIS.**
Northern Illinois Univ., De Kalb. Dept. of Geology.
C. J. Booth, and B. C. Price.
Journal of Hydrology JHYDA7, Vol. 108, No. 1-4, p 175-188, Jun 1989. 4 fig, 4 tab, 19 ref.

Descriptors: *Landfill covers, *Water pollution sources, *Groundwater pollution, *Landfills, *Infiltration, *Soil water, *Rainfall, *Runoff, *Percolation, Tensiometers, Hydraulic conductivity, Density, Subsidence, Mallard North Landfill, Illinois.

The cover of the Mallard North Landfill in northeastern Illinois is transected by numerous fractures and locally contains subsidence depressions in which intermittent ponds form. Field measurements using tensiometers and soil-moisture blocks showed that the upper 0.3 m of the cover in the non-fractured sites dries readily and is responsive to climatic events, whereas the fractures and, locally, the deeper cover retain moisture and respond only slightly to climatic events. Experiments with sprinkler and ring infiltrometers showed that infiltration rates are generally high, of the order of 1-10 cm/h in most tests, 0.1-1.0 cm/h locally, and above 100 cm/h into open fractures. Runoff from natural rainstorms, estimated from runoff-plot measurements and pond changes, is low across the landfill. Laboratory studies of bulk density and hydraulic conductivity suggest that the cover is composed of an upper, more permeable topsoil and a lower compacted layer. The study results suggest a hypothetical model in which most rainfall falling into the landfill infiltrates readily into the upper cover layer, then travels laterally along the top of the compacted layer until it reaches a fracture, whereupon it percolates deeper into the landfill. Percolation also occurs from runoff and interflow collected in subsidence ponds. The fractures and subsidence thus considerably increase the total percolation into the landfill compared with estimates from standard models which assume an unfrac-

tured cover and tabulated runoff and spoil-moisture conditions. (Author's abstract)
W90-01024

**SEEPAGE THROUGH A HAZARDOUS-WASTE TRENCH COVER.**
Geological Survey, Denver, CO.
For primary bibliographic entry see Field 5B.
W90-01026

**IMPROVING SOUTHERN CALIFORNIA'S COASTAL WATERS.**
Southern California Coastal Water Research Project Authority, Long Beach.
For primary bibliographic entry see Field 5G.
W90-01046

**WASTE DISPOSAL AND GROUNDWATER MANAGEMENT.**
Binnie and Partners, Redhill (England).
K. J. Edworthy.
Journal of the Institution of Water and Environmental Management, Vol. 3, No. 2, p 109-115, April 1989. 2 tab, 31 ref.

Descriptors: *Groundwater management, *Groundwater pollution, *Water conservation, *Water resources management, *Waste disposal, *Water quality management, Water conveyance, Water pollution prevention, Groundwater recharge, Water costs, Population density, Industrial wastes, Waste management, Aeration zone, Flow control, Legislation, England.

About one-third of the population of the U.K. depends on groundwater for their domestic supply. The replacement of a polluted supply can have considerable cost implications. The recharge areas of the two aquifers tapped correspond broadly with areas of high population density and substantial industrial activity. The disposal of solid and liquid wastes which are generated by this large population has caused local contamination of groundwater, and there is evidence of trace concentrations of a large range of man-made organic substances in public supplies. Groundwater pollution resulting from waste disposal is not widespread because of the protective properties of the unsaturated zone. Although total prevention of groundwater pollution is not feasible, it is increasingly evident that groundwater resources and quality management must involve improved waste disposal management. Techniques are available for controlling the rate of pollution from wastes such that adequate dilution can occur, by proper waste site management and engineering, and by groundwater flow control. Existing legislation and the expertise which is available in the water industry is adequate to ensure that serious pollution need not occur in the future. There is considerable scope for improvement in the monitoring arrangements for some authorities who all agree that prevention is better, and cheaper, than any cure. (Fish-PTT)
W90-01078

**CEMENT-BASED STABILIZATION OF WASTES: PRACTICAL AND THEORETICAL CONSIDERATIONS.**
C. J. Sollars, and R. Perry.
Journal of the Institution of Water and Environmental Management, Vol. 3, No. 2, p 125-134, April 1989. 4 fig, 5 tab, 21 ref.

Descriptors: *Concrete technology, *Waste stabilization, *Waste management, *Waste disposal, *Industrial wastes, *Landfills, *Environmental protection, Solid waste disposal, Physicochemical treatment, Cements, Waste characteristics, Testing procedures, Leachates.

Rapidly changing public and political attitudes to the environmental implications of industrial waste disposal are forcing a re-evaluation of the long-standing practice of directly landfilling such waste, either in a mono-disposal or co-disposal manner. As a result, more technology-oriented solutions to industrial waste disposal are being evaluated. One such process is cement-based stabilization/solidification, which has a physicochemical basis. This technology has both present-day and future applications. Areas where research is needed include evaluation of the effect of key parameters in the waste composition and of the nature of cement and cement substitutes on final product quality. Such studies will lay the foundations for a rigorous code of practice defining process operating parameters. A sound regime of relevant testing procedures needs to be developed; the most essential being simple, rapid and acceptable ways of assessing product quality before deposition and subsequent leachate evaluation. (Fish-PTT)
W90-01080

**HASTINGS AND BEXHILL DRAINAGE AND SEA OUTFALL SCHEMES.**
For primary bibliographic entry see Field 5D.
W90-01081

**UTILIZATION OF WASTE-GROWN ALGAE FOR FEEDING FRESHWATER SHRIMPS.**
Hong Kong Baptist Coll., Kowloon. Dept. of Biology.
M. H. Wong.
Resources, Conservation and Recycling, Vol. 2, No. 3, p 199-210, July 1989. 5 tab, 35 ref.

Descriptors: *Wastewater treatment, *Algae, *Shrimp, *Chlorella, *River shrimp, *Heavy metals, Soybeans, Farm wastes, Copper, Zinc, Manganese, Lead.

The purpose of this study was to investigate the possibility of using waste-grown algae as feeding materials for a freshwater shrimp (Macrobrachium hainanense). Chlorella pyrenoidosa cultured in 1% aqueous extracts of soybean waste and refuse compost waste materials were used to feed the shrimp. Five experimental groups were designed: (1) 100% commercial fish food (control group); (2) 50% algal product from soybean waste extract with 50% commercial fish food; (3) 100% algal product harvested from soybean extract; (4) 50% algal product from refuse compost extract with 50% commercial fish food; and (5) 100% algal product from refuse compost extract. After a feeding trial of 20 days, the contents of protein, lipid and soluble carbohydrates of the muscle of shrimps were analyzed. The nutrient contents (protein, lipid and soluble carbohydrates) of different feeds were also measured. It was found that shrimps fed with waste-grown algae seemed to maintain a similar nutrient level as the control group. Measurements of heavy metals (Cu, Zn, Mn, Pb) in the culture media, algae, commercial fish food, muscles, and cephalothorax and exoskeletons of shrimps were conducted. It was found that the algal product harvested from the refuse compost extract contained a higher metal content. The metals were mostly incorporated in the cephalothorax and exoskeleton of waste-grown shrimps. (Author's abstract)
W90-01103

**RECLAMATION OF WASTEWATER AND SLUDGE FOR CONCRETE MAKING.**
Nanyang Technological Inst., Singapore. School of Civil and Structural Engineering.
J.-H. Tay.
Resources, Conservation and Recycling, Vol. 2, No. 3, p 211-227, July 1989. 6 fig, 9 tab, 32 ref.

Descriptors: *Water reuse, *Wastewater disposal, *Sludge utilization, *Concrete additives, Resources management, Municipal wastewater, Sludge, Concretes, Wastewater renovation.

Sludge is an unavoidable product of wastewater treatment and creates problems of disposal. For highly urbanised cities, incineration of sludge might be a viable solution for sludge disposal. After incineration, a large quantity of ash is produced and must be disposed of by other means. The feasibility of using pulverized sludge ash as construction material was studied. The results indicate that pulverized sludge ash could be used as a partial replacement for cement in concrete as a means of waste disposal and resource recovery. Reclaimed wastewater can be used as mixing water for concrete. Reclaimed wastewater does not affect the properties of concrete, such as segregation, shrinkage, water absorption, bulk density, and setting times. The compressive strengths increase slightly at early ages from cubes cast with higher percentages of reclaimed wastewater as compared with those cast with potable water. However, at ages of three months or beyond, compressive strengths are similar. The properties of pulverized sludge ash concrete using reclaimed wastewater for mixing are similar to those of pulverized sludge ash concrete with potable water. (Author's abstract)
W90-01104

**CROP RESPONSE TO SLUDGE LOADING RATES.**
Arizona Univ., Tucson.
A. D. Day, M. A. Solomon, M. J. Ottman, and B. B. Taylor.
Biocycle BCYCDK, Vol. 30, No. 8, p 72-75, August 1989. 2 tab, 16 ref.

Descriptors: *Sludge disposal, *Fertilizers, *Heavy metals, *Barley, *Arizona, Nitrogen, Wastewater disposal.

In 1987 and 1988, a greenhouse experiment was conducted to study the effects of liquid sewage sludge loading rates on the vegetative growth, yield, and quality of barley (Hordeum vulgare L.) grain and straw. Sludge loading rates consisted of seven treatments, each replicated four times. Treatments included: (1) check, soil with no fertilizer; (2) recommended amount of N for barley, which is 112 kg N/ha from ammonium nitrate; (3) Liquid sewage sludge rates to provide the recommended amount of N; and (4-7) liquid sewage sludge rated to provide plant-available N in amounts equal to 2, 3, 4, and 5 times the recommended amount of N. Barley responded more in vegetative growth than in yield to increases in sewage sludge loading rates. Sewage sludge loading rates more than three times the recommended plant-available N rate decreased barley stands in the seedling stage. Sludge loading rates higher than the recommended plant-available N level tended to delay maturity, increase tillering, and increase straw yield. Grain yield was not increased by higher sludge application rates. Heavy metal concentrations in barley grain and straw and the amounts of metals recovered in the soil following each harvest were similar for all fertilizer treatments. The foregoing observations, in conjunction with Pima County's industrial sludge pretreatment requirements, indicate that, on the basis of heavy metals, sewage sludge from Tucson, Arizona is safe for disposal on crop lands at rates higher than those presently recommended. (Mertz-PTT)
W90-01108

**PUBLIC HEALTH ISSUES AND COMPOSTING.**
E and A Consultants, Stoughton, MA.
E. Epstein, and J. I. Epstein.
Biocycle BCYCDK, Vol. 30, No. 8, p 50-53, August 1989. 2 tab, 23 ref.

Descriptors: *Composting, *Molds, *Public health, *Bacteria, Viruses, Protozoa, Endotoxins, Helminths, Health effects.

This paper discusses the public health issues that are related to the design and operations of composting facilities. Particular emphasis is placed on methods that reduce the impact of potential health problems. Aspergillus fumigatus is common in composting operations. Studies show no trend to infection or allergic responses to workers at compost sites in the United States. Although Aspergillus colonization is more common in compost workers, infection with the organisms is not. Immunocompromised individuals may be predisposed to Aspergillus infections, however. Endotoxin levels in sludge compost were found to be similar to levels found in compost from leaves, cattle, and sheep. Data show that many other work environments have higher levels of endotoxins and workers are at greater risk than at composting facilities. Those individuals who are hypersensitive to allergens or predisposed to opportunistic infections may be at risk for health effects from endotoxins.

Other pathogens found in sludge, such as salmonella, tuberculli bacteria, yersinia, entroviruses, hepatitis, adenoviruses, nematodes, cestodes, giardia and entomeoba histolytic are heat sensitive and should be eliminated by proper composting. Key factors in designing safe composting facilities include uniform mixing, proper moisture, dust and temperature control, adequate building and vehicle/equipment ventilation, odor control, and paved surfaces for leachate and runoff control. Sound operator training is also essential for hygienic conditions. (Mertz-PTT)
W90-01109

**COMBINED PYROLYSIS COMBUSTION PLANT FOR DISPOSAL OF REFUSE AND SEWAGE SLUDGE (SCHWELBRENNVERFAHREN ZUR THERMISCHEN ENTSORGUNG VON MULL UND KLARSCHLAMM).**
GHH Gutehoffnungshuette Sterkrade A.G., Oberhausen (Germany, F.R.).
F. Vollhardt, and B. Lezenik.
Chemie-Ingenieur-Technik CITEAH, Vol. 61, No. 7, p 530-535, July 1989. 3 fig, 2 tab. English summary.

Descriptors: *Incineration, *Sludge disposal, *Solid waste disposal, Pyrolysis, Refuse disposal.

An environmentally compatible process for the disposal of refuse features a combination of pyrolysis and high-temperature combustion and utilizes well-proven equipment. Thermal decomposition of refuse by pyrolysis precedes high-temperature combustion leading to full energy utilization and resulting in optimum combustion and refuse disposal. The salient components of the process--the pyrolysing drum and the high-temperature combustion--are explained in detail. The report draws upon the operational experience obtained with pyrolysis plants and special waste incineration plants already installed. (Author's abstract)
W90-01146

**DISPOSAL OF RADIUM REMOVED FROM DRINKING WATER.**
Wisconsin Dept. of Natural Resources, Madison.
N. A. Hahn.
Journal of the American Water Works Association JAWWA5, Vol. 80, No. 7, p 71-78, July 1989. 9 tab, 12 ref.

Descriptors: *Water treatment, *Radioactive waste disposal, *Radium radioisotopes, *Drinking water, *Waste disposal, Water utilities.

Installing treatment technology to remove radium isotopes from drinking water is a problematic option for water utilities endeavoring to comply with federal radium standards promulgated in 1976 because of the long-term uncertainties of disposing of wastes containing radium. Wisconsin and Illinois have investigated and prepared guidelines for the disposal of such wastes. The author outlines this available guidance and describes the need for federal and state regulatory authorities to more closely consider disposal options and concerns to ensure more orderly enforcement of the drinking water standard for radionuclides. (Author's abstract)
W90-01160

**MODIFIED EXTENDED AERATION PROCESS FOR REMOVAL OF CADMIUM FROM WASTEWATERS.**
Delaware Univ., Newark. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5D.
W90-01254

**INDUSTRIAL SLUDGE WASTE INCINERATION.**
CH2M/Hill, Reston, VA.
C. R. Brunner.
Environmental Progress ENVPDI, Vol. 8, No. 3, p 163-165, August 1989. 4 fig.

Descriptors: *Waste disposal, *Sludge, *Incineration, *Industrial wastes, Wastewater treatment.

A type of sludge burning system, fluidized bed incinerator, is described, for disposing of waste streams. Primary and activated sludge generated at an industrial on-site wastewater treatment plant which produces plastics, additives, catalysts, surfactants animal feed intermediates. Sludge and liquid wastes are generated at the wastewater treatment plant and at other locations in the facility. Three waste streams are defined: (1) spent waste solvents, (2) high solids sludge, and (3) low solids sludge. High solids sludge originates in the secondary wastewater treatment system and low solids sludge is usually primary wastewater treatment sludge conditioned with both lime and alum. The heart of the incinerator's furnace system is the reactor, a vertical refractory-lined chamber. The injection of hot air into the sand bed creates a high degree of turbulence and the top of the bed appears as a fluid in motion. Off-gas from the bed will go into the volume above the bed, the freeboard, which is normally maintained at a temperature of 1600 F. Residual solids, including ash, will be elutriated in the gas stream exiting the reactor. A fluidizing air blower provides the air required to maintain fluidization of the sand bed. An induced draft fan maintains a negative pressure within the reactor freeboard. The scrubber is of radial design and scrubs flue gas exiting the heat exchanger with the plant process water. The water/ash slurry discharge leaving the scrubber is discharged to the surface impoundment on the plant site that is permitted for hazardous waste disposal. The system is designed to burn either high solids sludge or low solids sludge at any time, not both feeds at once. (Miller-PTT)
W90-01257

**SEWAGE PURIFICATION IN SOUTH AFRICA: QUO VADIS.**
Water Research Commission, Pretoria (South Africa).
For primary bibliographic entry see Field 5D.
W90-01403

**WASTE WATER IRRIGATION SUITED TO THE ENVIRONMENT AS SHOWN BY THE EXAMPLE OF THE 'ABWASSERVERBAND WOLFSBURG'.**
Technische Univ. Braunschweig (Germany, F.R.).
Inst. fuer Geologie.
For primary bibliographic entry see Field 3C.
W90-01679

**CO-TREATMENT OF MANUFACTURED GAS PLANT SITE GROUNDWATERS WITH MUNICIPAL WASTEWATERS.**
Gas Research Inst., Chicago, IL.
For primary bibliographic entry see Field 5D.
W90-01702

**INTERIM HYDROGEOLOGIC CHARACTERIZATION REPORT AND GROUNDWATER MONITORING SYSTEM FOR THE NONRADIOACTIVE DANGEROUS WASTE LANDFILL, HANFORD SITE, WASHINGTON.**
Westinghouse Hanford Co., Richland, WA.
For primary bibliographic entry see Field 5G.
W90-01708

**EVOLUTION OF THE GROUNDWATER CHEMISTRY AROUND A NUCLEAR WASTE REPOSITORY.**
UKAEA Atomic Energy Research Establishment, Harwell (England). Theoretical Physics Div.
For primary bibliographic entry see Field 5G.
W90-01722

**CLOSURE PLAN FOR THE DECOMMISSIONED HIGH EXPLOSIVES RINSE-WATER LAGOONS AT LAWRENCE LIVERMORE NATIONAL LABORATORY SITE 300.**
Lawrence Livermore National Lab., CA. Environmental Restoration Div.
For primary bibliographic entry see Field 5G.
W90-01723

**REPORT 1986 (BERICHT 1986).**
Technische Univ. Hamburg-Harburg (Germany, F.R.). Arbeitsbereich Gewaesserreinigungstechnik.
For primary bibliographic entry see Field 5D.
W90-01746

## 5F. Water Treatment and Quality Alteration

**MUNICIPAL UTILIZATION OF WATER DEMAND MANAGEMENT THE ONTARIO EXPERIENCE.**
Guelph Univ. (Ontario). Dept. of Geography.
R. D. Kreutzwiser, and R. B. Feagan.
Water Resources Bulletin WARBAQ, Vol. 25, No. 3, p 667-674, June 1989. 4 tab, 38 ref.

Descriptors: *Water demand, *Municipal water, *Water supply, *Ontario, Water conservation.

Managing the demand for municipal water supply has become a viable alternative or supplement to traditional supply management responses. Though senior governments in Canada are committed to the concept, there is a lack of knowledge concerning the level of use of the demand management concept and little promotion of water conservation. This paper assess the extent of the use of this concept as it applies to municipal water supply across southern Ontario and examines factors that influence the variation in use of water conservation strategies. Information from 219 municipalities revealed that the concept is not in wide use in southern Ontario and that existing variation can be partially explained by the extent of problems experienced and the population size served by the municipal water supply system. Suggestions for increasing municipal use of the demand management concept are offered. (Author's abstract)
W90-00982

**KINETICS OF REACTIONS IN SOLUTIONS CONTAINING MONOCHLORAMINE AND BROMIDE.**
University of East Anglia, Norwich (England). School of Environmental Sciences.
A. Bousher, P. Brimblecombe, and D. Midgley.
Water Research WATRAG, Vol. 23, No. 8, p 1049-1058, August 1989. 9 fig, 2 tab, 23 ref.

Descriptors: *Water treatment, *Chlorination, *Drinking water, *Bromides, *Ammonium compounds, Chloramines, Free chlorine, Kinetics, Thermodynamics, Hydrogen ion concentration.

The reactions of monochloramine in saline solutions containing bromide have been investigated. Monochloramine may be either a product or by-product of the chlorination of water. In potable waters it is formed deliberately by adding ammonia to the system, because monochloramine is more persistent, although less active, than 'free chlorine'. Monochloramine oxidizes the bromide ion via NH3Cl(+) formation. The rate constant for the second-order reaction was found to be 6 (+ or -)10,000 mol/cu dm/sec at 25C. Further rapid reactions follow, resulting predominantly in the formation of NHBr2, NBr2(-)and NClB(-) at pH approx. 7. The distribution of these species appears to be thermodynamically controlled and dependent upon the pH, the ionic strength and chloride/bromide ratio. These species decay through a series of reaction steps resulting in nitrogen formation. In unbuffered solutions, these reactions can lower the pH sufficiently for Br3(-) formation to occur. (Author's abstract)
W90-01005

**OPERATING EXPERIENCES OF FULL-SCALE BIOLOGICAL AND ION-EXCHANGE DENITRIFICATION PLANTS IN FRANCE.**
Y. R. Richard.
Journal of the Institution of Water and Environmental Management, Vol. 3, No. 2, p 154-167, April 1989. 12 fig, 9 tab, 8 ref.

Descriptors: *Water treatment facilities, *France, *Denitrification, *Biological treatment, *Ion exchange, *Water quality control, *Water resources

development, Nitrates, Wastewater facilities, Raw water, Temperature, Automation, Sludge, Performance evaluation, Design criteria.

In France, nitrate removal by biological means was authorized in 1981 and by ion exchange in 1985. To date, four installations use the biological process and six plants incorporate ion exchange techniques. The first conclusions can now be drawn from the results of the startup period as well as from operation. The existing facilities produce water in compliance with specified regulations, and in a reliable manner throughout the year. In comparing the characteristics of the two processes, it is not possible to say that one technique is better than the other. The designer has to choose the most suitable in accordance with the local conditions; e.g. quality of raw water, temperature, degree of automation required, possibility of eluates (or sludge) and their disposal. (Fish-PTT)
W90-01082

**APPLICATION OF GRANULAR ACTIVATED CARBON IN THE WATER INDUSTRY.**
Water Research Centre, Stevenage (England).
R. A. Hyde.
Journal of the Institution of Water and Environmental Management, Vol. 3, No. 2, p 174-181, April 1989. 3 fig, 2 tab, 9 ref.

Descriptors: *Activated carbon, *Water treatment, *Water treatment facilities, *Adsorbents, Odor control, Organic compounds, Chlorinated hydrocarbons, Pesticides, Oil pollution, Molecular structure, Mathematical models.

Until the mid-1980s, granular activated carbon (GAC) was used in only a small number of water treatment plants in the U.K. Since then the material has been installed in over 30 plants, either as a result of an operational decision to treat the water by GAC or for the purpose of full-scale experiments. GAC is used for a variety of reasons including taste and odor control, removal of a wide range of synthetic organic compounds (for example volatile chlorinated solvents, pesticides, and oils) of molecular weight 100-500, and adsorption of trihalomethane precursors (molecular weight 1,000-100,000). The performance of different GACs for a particular duty may vary by a factor of 10, and the best GAC for one application may be the worst for another. Thus, to minimize the cost of GAC treatment, it is essential to identify the purpose for which GAC is being used and then to select, by pilot trials or by more rapid laboratory procedures and mathematical modelling, the most appropriate GAC for that particular application. (Author's abstract)
W90-01083

**METERING TRIALS FOR WATER SUPPLY.**
D. Gadbury.
Journal of the Institution of Water and Environmental Management, Vol. 3, No. 2, p 182-187, April 1989. 2 tab, 3 ref.

Descriptors: *Water rates, *Pricing, *Water metering, *Water costs, *Domestic water, Cost-benefit analysis, Tariff, Climatic zones, England, Performance evaluation.

The U.K. government's intention to abolish the rateable value system of charging for water has made it urgent for the water industry to develop an alternative method of charging for its domestic customers. Metering is one option which will offer the U.K. water industry a unique opportunity to provide better information and experience on how to implement an effective metering system and the likely cost. Furthermore they should also provide better information on customer demand for water which will enable forecasts of revenue income to be made, and help to determine future metered tariffs. The small-scale trials will offer a number of water undertakings some metering experience. They will also enable various metering systems and metering technology to be investigated under different tariffs, property types, and climatic areas of the country. All the trials will last for three years. It is important that a careful study is made of the metering trials to assist the water industry to move away from rate-base charging to new charging schemes. (Fish-PTT)
W90-01084

**WATERAID AND THE THIRD WORLD--A PARTNERSHIP IN LOW-COST TECHNOLOGY.**
I. A. Richardson.
Journal of the Institution of Water and Environmental Management, Vol. 3, No. 2, p 188-197, April 1989. 3 fig, 1 tab.

Descriptors: *Community development, *Public participation, *Water supply development, *Water costs, *Resources development, *Developing countries, Sanitation, Technology, Training, Community development, Africa, Asia, Charitable organizations.

WaterAid, a registered charity, is working with local partners in Africa and Asia on small-scale primary water supply projects, basic sanitation and hygiene education, for poor Third-World communities. Programs are aimed at lasting development, not disaster relief. Low-cost technologies are used, preferably including proven local techniques. This, combined with training local staff, increases the probability of replication occurring through WaterAid's local operational partners. Methods employed fully involve the benefiting community; their participation is of course essential if they are to run and maintain their new supply successfully. Finally it is expected that poor communities achieving their own protected water supply will gain confidence to tackle other development needs. (Author's abstract)
W90-01085

**DESIGN AND CONSTRUCT CONTRACTS IN THE WATER INDUSTRY: I. THE WAY AHEAD--THE CLIENT'S VIEWPOINT.**
Yorkshire Water Authority (England).
A. I. Ward, and C. Burke.
Journal of the Institution of Water and Environmental Management, Vol. 3, No. 3, p 235-238, June 1989.

Descriptors: *Water costs, *Economic aspects, *Contracts, Risks, Project planning, Construction costs, Negotiations, Water management, England.

A basic dilemma exists for a water authority in the U.K. in determining how best to achieve the balance of risk sharing to obtain satisfactorily low competitive prices for its works while maintaining the possibility of the widest choice of options. Design and construct contracts can be applied to meet the authority's objectives. Consideration must be given to the demands placed on the client and how inherent disadvantages can be overcome. There is some question as to the ability of the industry to meet the challenge. (See also W90-01090 and W90-01091) (Author's abstract)
W90-01089

**RADIONUCLIDES IN DRINKING WATER.**
Maine Univ. at Orono. Dept. of Civil Engineering.
J. D. Lowry, and S. B. Lowry.
Journal of the American Water Works Association JAWWA5, Vol. 80, No. 7, p 50-64, July 1989. 11 tab, 93 ref.

Descriptors: *Radium radioisotopes, *Drinking water, Radon, Health effects.

Impending new maximum contaminant levels for radionuclides, plus increased concern for radon in the air inside homes, have sparked new interest in these substances. An assessment of research needs, which also provided background information on completed and ongoing research projects, showed the Rn-222 represents the most serious threat to health of all the radionuclides in drinking water, leading to the anticipation that the new maximum contaminant levels for these substances could be set at a relatively low level. Small public and private supplies were identified as being more vulnerable to radionuclide contamination than public systems serving more than a few hundred people, but more investigation is needed to assess the extent of the exposure and its associated risk. The previous belief that high levels of Rn-222 are confined to a few geographic areas was found to be false, largely because of a lack of a nationwide data base. (Author's abstract)
W90-01158

**OCCURRENCE OF RADON IN WELL SUPPLIES.**
American Water Works Service Co., Voorhees, NJ. System Water Quality Dept.
K. L. Dixon, and R. G. Lee.
Journal of the American Water Works Association JAWWA5, Vol. 80, No. 7, p 65-70, July 1989. 1 fig, 8 tab, 9 ref.

Descriptors: *Radium radioisotopes, *Drinking water, *Wells, *Groundwater pollution, New Jersey, Water utilities.

In 1986 and 1987, a survey was conducted of the occurrence of radon in well water within the American Water Works Company system. It was observed that the highest levels of radon occurred in the northeastern part of the United States and were associated with formations of uranium-bearing granitic rocks. The decrease in radon levels in water stored within the distribution system was attributable primarily to volatilization of the gas. Blending of radon-free surface water with radon-laden groundwater resulted in a water with a radon concentration that is a function of volumetric dilution. The use of granular activated carbon to reduce radon levels was found to be impractical, but aeration was observed to be cost-effective as well as efficient. (Author's abstract)
W90-01159

**DISPOSAL OF RADIUM REMOVED FROM DRINKING WATER.**
Wisconsin Dept. of Natural Resources, Madison.
For primary bibliographic entry see Field 5E.
W90-01160

**OPERATING A SMALL FULL-SCALE ION EXCHANGE SYSTEM FOR URANIUM REMOVAL.**
Arber (Richard P.) Associates, Inc., Denver, CO.
R. T. Jelinek, and T. J. Sorg.
Journal of the American Water Works Association JAWWA5, Vol. 80, No. 7, p 79-83, July 1989. 1 fig, 8 tab, 9 ref. USEPA Order 7C7639NNSE.

Descriptors: *Uranium, *Water treatment facilities, *Ion exchange, Colorado, Wastewater disposal, Anions, Drinking water.

The design and operation of a small full-scale ion exchange system used to remove uranium from well water in the foothills west of Denver, CO., are described. Consistent removal of uranium was accomplished by anion exchange treatment at a reasonable cost. Because of a lack of clear regulatory guidelines, disposal of the uranium-laden regenerant wastewater was the most complicated task associated with this treatment system. Gamma radiation buildup did not appear to be a health concern. (Author's abstract)
W90-01161

**EVALUATING VARIOUS ADSORBENTS AND MEMBRANES FOR REMOVING RADIUM FROM GROUNDWATER.**
Houston Univ., TX. Dept. of Civil and Environmental Engineering.
D. Clifford, W. Vijjeswarapu, and S. Subramonian.
Journal of the American Water Works Association JAWWA5, Vol. 80, No. 7, p 94-104, July 1989. 7 fig, 10 tab, 35 ref. University of Houston and USEPA cooperative research agreement CR-813148.

Descriptors: *Groundwater pollution, *Water treatment, *Adsorbents, *Reverse osmosis, *Radium radioisotopes.

Field studies were conducted in Lemont, Ill., to evaluate specific adsorbents and reverse osmosis

membranes for removing radium from groundwater. A radium-selective complexer and barium-sulfate-loaded alumina appeared to have the best potential for low-cost adsorption of radium from raw water or ion exchange brines, provided that the problems of the ultimate disposal of spent media can be solved. A new low-pressure (70-psig) reverse osmosis module achieved radium and total dissolved solids rejections of 91 and 87%, respectively. Central treatment with standard or low-pressure reverse osmosis modules would be effective for radium removal, but expensive and unnecessary if total dissolved solids reduction is not also required. Point-of-use treatment using reverse osmosis is effective for removing radium and may be cost effective for very small communities. (Author's abstract)
W90-01163

**METHODS FOR REMOVING URANIUM FROM DRINKING WATER.**
Environmental Protection Agency, Cincinnati, OH. Drinking Water Research Div.
T. J. Sorg.
Journal of the American Water Works Association JAWWA5, Vol. 80, No. 7, p 105-111, July 1989. 8 fig, 6 tab, 15 ref.

Descriptors: *Uranium, *Drinking water, *Water treatment, Radium radioisotopes, Groundwater pollution, Water pollution.

The US Environmental Protection Agency has both sponsored several extramural research projects and conducted in-house research on uranium removal treatment. This article summarizes recent information on the effectiveness of various treatment methods to remove uranium from drinking water supplies. Because uranium is found in both surface water and groundwater, a variety of methods has been studied. Most of the information presented here, however, was developed from either laboratory or pilot-plant studies because only limited data exist on full-scale treatment systems. (Author's abstract)
W90-01164

**IDENTIFICATION OF OZONATION BY-PRODUCTS OF LIGNIN AND OF CARBOHYDRATES IN WATER (ETUDE DES SOUS-PRODUITS D'OZONATION DE LA LIGNINE ET DE GLUCIDES EN MILIEU AQUEUX).**
Poitiers Univ. (France). Lab. de Chimie de l'Eau et des Nuisances.
M. C. Bonnet, J. de Laat, and M. Dore.
Environmental Technology Letters ETLEDB, Vol. 10, No. 6, p 577-590, June 1989. 8 fig, 6 tab, 35 ref.

Descriptors: *Water treatment, *Pollutant identification, *Ozone, *Ozonation, *Carbohydrates, Pure water, Water analysis, Gas chromatography, Mass spectrometry, Organic compounds, Oxidation.

Ozonation by-products of lignin and carbohydrates were characterized. Aqueous solutions of a commercial lignin and of carbohydrates (glucose, xylose, cellulose) were ozonated in ultra-pure water (initial concentration: 1 g/L). The results showed that ozonation of lignin (ozone dose < 0.8 mg O3 consumed/mg of DOC) significantly decreases the aromaticity of the organic matter and leads to the production of carboxylic acids. Many aromatic acids were identified by gas chromatography and mass spectrometry analyses for low ozone doses (< 0.5 mg O3 consumed/mg DOC) whereas aliphatic acids were the major oxidation by-products identified for higher ozone doses (> 0.5 mg O3/mg DOC). Aldonic acids were formed during the ozonation of glucose and of cellulose (gluconic acid) and of xylose (xylonic acid). Aldoses were also identified in ozonated samples of glucose (arabinose) and of cellulose (glucose, arabinose). Dissolved organic carbon concentration (DOC) and formic acid productions were also measured in this study. (Author's abstract)
W90-01234

**ALTERNATIVE DISINFECTANT CHEMICALS FOR TRIHALOMETHANE CONTROL: A REVIEW.**
Imperial Coll. of Science and Technology, London (England). Dept. of Civil Engineering.
G. Reynolds, C. Mekras, R. Perry, and N. Graham.
Environmental Technology Letters ETLEDB, Vol. 10, No. 6, p 591-600, June 1989. 53 ref.

Descriptors: *Water treatment, *Chlorination, *Disinfection, *Water quality control, *Water quality, *Chlorine, Comparison studies, Drinking water, Potable water, Reviews.

Chlorination is the most commonly used and best characterized process for disinfection of drinking water. Concern over the possible health risks of chlorination by-products, particularly trihalomethanes, has led to a re-evaluation of existing treatment processes and the benefits of using alternative disinfectants to chlorine. The general characteristics of, and the advantages and disadvantages of, four possible alternative disinfectants (ozone, chlorine dioxide, chloramines and potassium permanganate) in drinking water treatment are reviewed. Among the alternative chemicals that might be used as a pre-disinfectant, chlorine dioxide and especially potassium permanganate are limited in their application by mandatory recommended maximum admissable standards for their residuals, or inorganic by-product residuals. It is widely believed that ozone will replace chlorine as the pre-disinfectant chemical of choice for surface waters. The short contact times needed with ozone to achieve both disinfection and the other oxidative pretreatment objectives, together with the absence of THM or other chlorinated by-products, mean that ozonation generally represents the 'Best Available Technology' for combined preoxidation/pre-disinfection. (Author's abstract)
W90-01235

**ECOLOGICAL ANALYSES AND CASE-CONTROL STUDIES OF GASTRIC CANCER AND LEUKAEMIA IN RELATION TO DBCP IN DRINKING WATER IN FRESNO COUNTY, CALIFORNIA.**
Environmental Health Associates, Inc., Berkeley, CA.
O. Wong, R. W. Morgan, M. D. Whorton, N. Gordon, and L. Kheifets.
British Journal of Industrial Medicine BJIMAG, Vol. 46, No. 8, p 521-528, August 1989. 12 tab, 9 ref.

Descriptors: *Human pathology, *Cancer, *Epidemiology, *Drinking water, Contamination, Dibromochloropropane, Leukemia, Fresno County, California.

Through ecological analyses and case-control studies, the possible relation of gastric cancer and leukemia to dibromochloropropane (DBCP) contamination of drinking water was examined. The ecological analyses examined the correlation between gastric cancer and leukemia (including the lymphatic varieties), mortality rates, and DBCP concentrations in drinking water by census tract in Fresno County, California, 1960-83. No correlation was found between gastric cancer or leukemia and DBCP. The gastric cancer case-control study consisted of 263 deaths from gastric cancer in the county, 1975 to mid-1984, and 1044 controls, using information on residential history and occupation of both cases and controls. Analyses were based on residence at death, as well as one and ten years before death. The case-control study did not find any relation between gastric cancer and DBCP in drinking water. Hispanics in the county were found to experience a relative risk of gastric cancer of 2.77, compared with non-Hispanics. A similar case-control study consisting of 259 cases of leukemia and 1161 controls found no relation between all leukemias or lymphatic leukemia and DBCP in drinking water. Farm workers, however, do appear to have an increased risk of leukemia. (Author's abstract)
W90-01312

**AQUEDUCT AND RESERVOIR CAPACITIES FOR DISTRIBUTION SYSTEMS.**
Hampton Univ., VA.
L. E. Flynn, and M. A. Marino.
Journal of Water Resources Planning and Management (ASCE) JWRMD5, Vol. 115, No. 5, p 547-565, September 1989. 2 fig, 2 tab, 18 ref, append. University of California, Davis, and Agricultural Research Service Cooperative Agreement 4116-H.

Descriptors: *Water delivery, *Water conveyance, *Farm management, *Water distribution, *Water use efficiency, Operating policies, Reservoir capacity, Water demand, Water loss, Water management, Water storage, Irrigation requirements.

The determination of the design capacity and operation policy of water delivery systems for farming areas is complicated by the temporal variability of demands and the corresponding use of delivery capacity, the probabilistic occurrence of supplies, the spatial distribution of users, and losses in the distribution systems. A general method has been developed to integrate the choices of delivery system capacity and of conjunctively operated local reservoir capacities (the decisions of delivery system operators and farmers) to make more efficient use of water resources. The method consists of using the results from local economic optimization models of farm water requirements and benefits in a discrete dynamic programming model of the delivery system to determine the most efficient method of distributing limited water supplies. This method (1) allows variable peak-delivery proportions; (2) includes local (on-farm) intrayear storage; (3) is compatible with many other existing optimization models for farms; (4) addresses irrigation scheduling problems; and (5) addresses efficiency-equity conflicts. (Author's abstract)
W90-01343

**IMPROVING WATER DELIVERY SYSTEM OPERATION USING TRAINING SIMULATORS.**
Rose-Hulman Inst. of Tech., Terre Haute, IN. Civil and Mechanical Engineering Div.
R. J. Houghtalen, and J. C. Loftis.
Journal of Water Resources Planning and Management (ASCE) JWRMD5, Vol. 115, No. 5, p 616-629, September 1989. 1 fig, 3 tab, 24 ref.

Descriptors: *Training, *Simulation, *Water delivery, *Multireservoir networks, *Dynamic programming, Municipal water, Irrigation ditches, Operating policies, Mathematical analysis, Graphical methods, Resource allocation, Model testing.

The use of graphical-display training simulators is presented as a means of enhancing efficiency in operating multireservoir water delivery systems. Water delivery systems of this type include municipal water supply systems and irrigation water delivery systems (ditch companies). As a stand-alone tool, the training simulator can improve human operational performance. However, a coupling of human operational capabilities and mathematical programming techniques may also be beneficial. The mathematical programming technique called aggregate state dynamic programming (ASDP) explicitly draws upon the knowledge base of the system operator. Augmentation of that knowledge base is possible through the use of graphical-display training simulators to obtain improved operating rules for spatial allocation of water. The dynamic programming component of ASDP handles the temporal allocation. A case study is presented to display the application of the procedure and to provide direct comparisons against human operational performance. (Author's abstract)
W90-01347

**WATER DISTRIBUTION SYSTEM DESIGN UNDER UNCERTAINTIES.**
Oklahoma State Univ., Stillwater. School of Civil Engineering.
K. E. Lansey, N. Duan, L. W. Mays, and Y.-K. Tung.
Journal of Water Resources Planning and Management (ASCE) JWRMD5, Vol. 115, No. 5, p 630-645, September 1989. 7 fig, 4 tab, 13 ref. National Science Foundation Grant No. ECE-8511399.

Descriptors: *Water distribution, *Cost analysis, *Network design, Water demand, Pressure head, Pipe flow, Roughness coefficient, Optimization, Nonlinear programming, Mathematical models.

There is currently no universally accepted definition or measure of the reliability of water distribution systems. A chance constrained model is presented for the minimum cost design of water distribution networks. This methodology attempts to account for the uncertainties in required demands, required pressure heads, and pipe roughness coefficients. The optimization problem is formulated as a nonlinear programming model which is solved using a generalized reduced gradient method. Results of model applications illustrate that uncertainties in future demands, pressure head requirements, and pipe roughness can have significant effects on the optimal network design and cost. (Author's abstract)
W90-01348

**CCGP MODEL FOR MULTIOBJECTIVE RESERVOIR SYSTEMS.**
Northern Kentucky Univ., Highland Heights. Dept. of Management and Marketing.
C. Changchit, and M. P. Terrell.
Journal of Water Resources Planning and Management (ASCE) JWRMD5, Vol. 115, No. 5, p 658-670, September 1989. 2 fig, 2 tab, 25 ref.

Descriptors: *Multipurpose reservoirs, *Reservoir operation, *Model studies, *Water management, *Multiobjective planning, Flood protection, Municipal water, Industrial water, Hydroelectric power, Recreation, Probabilistic process, Flow rates, Stochastic process, Distribution, Model testing, Oklahoma.

Chance-constrained goal programming (CCGP) methodology can be applied to a reservoir system with multiple objectives. Several objectives which may be conflicting and noncommensurate such as flood protection, municipal and industrial water supply, hydroelectric power generation, recreation, etc. are considered in the model. The system goals and constraints are expressed either deterministically or probabilistically depending on whether the random variable term for inflow into a reservoir is present or not. For a constraint, the requirement must be strictly satisfied. For a goal, it is desired to achieve the solution which is as close to the specified target. Stochastic inflows with one period correlation in successive periods are explicitly considered with conditional distribution functions based on normal and lognormal distributions of inflows provided. The application of the methodology to a three-reservoir system in Oklahoma is reported. The proposed model uses a time period of a month and may be employed for planning rather than real-time applications. (Author's abstract)
W90-01350

**NETWORK MODELS OF WATER RIGHTS AND SYSTEM OPERATIONS.**
WBLA, Inc., Boulder, CO.
For primary bibliographic entry see Field 6E.
W90-01352

**LEAD INTOXICATION FROM LEAD-CONTAMINATED WATER USED TO RECONSTITUTE INFANT FORMULA.**
Children's Hospital, Boston, MA.
M. Shannon, and J. W. Graef.
Clinical Pediatrics CPEDAM, Vol. 28, No. 8, p 380-382, August 1989. 15 ref.

Descriptors: *Lead, *Toxicity, *Drinking water, Lead exposure, Plumbosolvency, Water conveyance, Hydrogen ion concentration, Nutritional factors.

Mounting clinical evidence indicates that low levels of lead exposure have a significant impact on the cognitive development of neonates and young children. A case is reported of a 13-month-old infant who was discovered to have plumbism during a routine evaluation. The lead source was ultimately traced to the daily administration of powdered formula which was prepared with home tap water having a first-draw lead content of 130 ppb. When daily lead intake reaches 5 microg/ kg of body weight a positive lead balance appears. The development of lead burden in children is amplified by several nutritional factors. These include iron deficiency, which enhances lead absorption as much as fivefold. In addition, children may normally absorb up to 50 percent of ingested lead in contrast to an average 10 percent absorption in adults. The EPA recommends that the lead concentration of water be minimized by actions such as the removal of lead pipes, reduced use of lead-based solder and pH adjustment of water to increase alkalinity, thereby reducing plumbosolvency. Finally, because water from plumbing systems containing lead has its highest lead content in the first-draw morning water, a 1 to 5 minute flush of tap water each morning is recommended as an additional measure to reduce lead content. (White-Reimer-PTT)
W90-01370

**BEATING THE PEAK IN SUMMER DEMAND.**
CH2M Hill, Inc., Austin, TX.
L. Amans, and E. Jones.
Southwest and Texas Water Works Journal STWJDV, Vol. 77, No. 4, July 1989.

Descriptors: *Aquifers, *Peak demand, *Water storage, *Water treatment facilities, *Water management, Water use, Texas, Aquifer storage and recovery, Water requirements, Metropolitan water management.

Many aquifers holding even brackish waters unsuitable for drinking water supply can safely and efficiently hold treated water under an aquifer storage and recovery (ASR) program that can help minimize costs associated with peak demand periods. Several sites in Texas appear to have good potential for ASR. In areas suitable for ASR, at least 50% of the cost associated with treatment plant or transmission main enlargements can be saved. Other benefits include: more effective use of water treatment plant and/or pipeline capacity; a large reservoir of treated water is readily available; management of river water resources is improved; and in some cases saltwater intrusion can be prevented. Although the concept of ASR is new in Texas, there are seven known ASR systems operational in the United States. Conditions necessary to determine if ASR is feasible in a particular setting are: (1) A seasonal variation in water supply, demand, or both. The maximum day demand should be at least 1.3 times the average day demand; (2) A useful ASR recovery capacity exceeding 1 mgd; and (3) a suitable ASR storage zone, as determined by engineering, hydrogeologic, water quality, economic, geochemical and other criteria. Typically, an ASR test program requires about three years to confirm feasibility and to complete one fully permitted, operational ASR well. Additional ASR wells can then be added easily as the need arises. (White-Reimer-PTT)
W90-01382

**WORLD'S LARGEST NEW POTABLE WATER SYSTEM.**
DuPage Water Commission, Villa Park, IL.
J. J. Holzwart, and D. E. Eckmann.
Water Engineering and Management WENMD2, Vol. 136, No. 8, p 25-26, August 1989.

Descriptors: *Water treatment facilities, *Illinois, *Water transfer, *Water shortage, *Municipal water, DuPage County, Chicago, Water supply, Costs, Construction, Management planning.

As a result of anticipated water supply shortages a system was devised to transfer treated Lake Michigan water to 700,000 residents in 24 DuPage County, Illinois municipalities. At the end of 1983, the DuPage Water Commission signed a 40-year agreement to buy water from the city of Chicago. The water will be delivered through interconnection facilities joining the Chicago tunnel system to the new DuPage Water Commission installation. The commission has to purchase and pay for a specified minimum volume of treated water per year. The maximum withdrawal rate from the interconnection facilities has been set at 9,167,000 gallons per hour or 220 mgd. Under the water-supply contracts, each municipal customer has agreed to purchase its potable water requirements from the DuPage Water Commission. Likewise the commission must sell each customer the volume it needs. The arrangement for constructing, operating and owning the interconnection facilities is unique. The DuPage Water Commission will construct the interconnection facilities and then sell it to Chicago. In 1993, the outcome of this megaproject will be a safe and reliable water supply for DuPage county's citizens. (White-Reimer-PTT)
W90-01383

**JAPANESE MUNICIPALITIES FIND ANOTHER WAY TO ADD LIME.**
Nihon Suido Consultants Co. Ltd., Tokyo (Japan).
S. Kojima.
Water Engineering and Management WENMD2, Vol. 136, No. 8, p 40-42, August 1989.

Descriptors: *Corrosion control, *Corrosion, *Lime, *Water treatment, Hydrogen ion concentration, Caustic soda, Soda ash, Slaked lime, Scaling, Solubility.

To raise the pH of the corrosive Japanese water caustic soda, soda ash, and slaked lime can be used. The caustic soda process is the most popular method in Japan because of its easy handling, even though the cost is high and the hazard of sodium to health is confirmed. Lime, when used in powder, has a number of drawbacks. The powder is difficult to handle and measure accurately because of scattering. Lime, when used in slurry, is difficult to measure accurately because of rapid sedimentation in the water. A change of concentration takes place at the dosing site. These drawbacks will disappear when lime solution is used. However, the solubility of lime in water is very low. The slaked-lime system has been developed to take advantage of the small solubility of lime. By constantly running water into the bottom of a storage tank, the system can produce the saturated solution of lime continuously. The storage tank is therefore used as a dissolving tank. Measuring lime this way is easy and accurate because the measurement is based on the amount of clean, potable water fed into the system before dissolving the lime. The solution does not contain any insoluble matter and can therefore be used in the final stage, the best place for corrosion control. In the slaked-lime system itself, a thin calcium film is formed on the inside (which protects against corrosion), but no scaling trouble has occurred. (White-Reimer-PTT)
W90-01384

**STREAMLINING BACKFLOW PREVENTION PROGRAMS.**
Asay and Associates, Northglenn, CO.
S. F. Asay.
Water Engineering and Management WENMD2, Vol. 136, No. 8, p 32-35, August 1989.

Descriptors: *Water treatment facilities, *Water pollution prevention, *Backflow, *Backflow prevention, Plumbing, Inspection, Compliance programs, Owner-compliance program.

During the past decade, the interest level in water supply protection through backflow prevention has increased dramatically. To meet the EPA's suggestions for a comprehensive backflow prevention program, the following steps are commonly observed by water suppliers: (1) Adopt an ordinance, rules and regulations, or specifications. These rules usually make uncontrolled cross connections illegal; (2) Require inspections and hazard assessments; (3) Install and test the backflow preventers; and (4) Educate the public. It is suggested that in order to simplify the need for a water utility to conduct water-use surveys through cursory plumbing inspections, a utility may simply add a clause to the contract stating that a user must demonstrate compliance with the plumbing code. Once plumbing-code compliance is established, this certificate may be requested annually or more frequently, depending on the potential hazard of the

system user. A plumbing-system compliance program will substantially reduce the fiscal impact of a backflow prevention program for the water utility. By instituting an owner-compliance program, the supplier will not have to hire and train several professionals to conduct plumbing-system surveys, or develop regulations to maintain the program. (White-Reimer-PTT)
W90-01385

**FLOW-INJECTION ANALYSIS OF SUBSTANCES IN WATER: PART II. CATIONS, A CRITICAL REVIEW.**
Pretoria Univ. (South Africa). Dept. of Chemistry.
J. F. van Staden.
Water SA WASADV, Vol. 15, No. 3, p 153-168, July 1989. 14 tab, 68 ref.

Descriptors: *Water analysis, *Water treatment, *Reviews, *Water quality control, *Water quality, *Heavy metals, Pollutant identification, Laboratories, Cations, Chromium, Zinc, Cadmium, Nickel, Cobalt, Manganese, Calcium, Potassium, Sodium, Iron.

For effective control of water quality, a routine water laboratory should be geared to analyze large numbers of samples rapidly and reliably, making use of proven methods of analysis. A critical review of the present status of flow-injection analysis (FIA) of cations in water is given, highlighting the possibilities of FIA in this area, such as methods for the determination of ammonium, calcium, magnesium, potassium, sodium, iron, copper, aluminum, lead, chromium, zinc, cadmium, nickel, cobalt, manganese, and molybdenum. Results are compared to those of previous authors. Overall, the potential and great capability of different FIA systems in water laboratories is demonstrated. It appears that flow-injection analysis has taken a prominent place in routine water laboratories where a widespread application of FIA methodologies is possible. (Author's abstract)
W90-01405

**DRINKING WATER QUALITY CRITERIA WITH SPECIAL REFERENCE TO THE SOUTH AFRICAN EXPERIENCE.**
Water Research Commission, Pretoria (South Africa).
M. J. Pieterse.
Water SA WASADV, Vol. 15, No. 3, p 169-178, July 1989. 5 tab, 31 ref.

Descriptors: *Drinking water, *South Africa, *Potable water, *Water quality standards, Public health, Water quality control, Risks, Administrative regulations, Water management.

Drinking water quality is defined and the difference between quality criteria and quality standards is emphasized. Methods for the establishment criteria/standards are addressed and special reference is made to risk assessment and risk management. A comparison is drawn between the criteria/standards used in the United States, Europe, South Africa, and those suggested by the World Health Organization (WHO). Special attention is focused on South African quality criteria, where a three-tier system setting maximum levels for no risk, insignificant risk, and low risk has been proposed. No single set of standards could be applicable to all nations, but there is a remarkable degree of agreement about which contaminants should be regulated and at what levels. Although South Africa does not have enforceable drinking water quality standards, well-defined criteria/guidelines are used to ensure a high quality of potable water supply. These criteria compare, as far as the microbiological and inorganic/aesthetic determinands are concerned, very favorably with the U.S. Environmental Protection Agency, WHO and European Economic Community regulations. However, South Africa's drinking water quality criteria do not yet provide for organic compounds and detailed radioactive limits. With the proposed three-tier system, pragmatism is attempted, rather than imposition of the concept of health risk ranges for various water quality variables. (Friedmann-PTT)
W90-01406

**EFFECT OF HUMIC SUBSTANCES ON THE TREATMENT OF DRINKING WATER.**
Centre de Recherche Lyonnaise des Eaux - Degremont, Le Pecq (France).
A. Bruchet, C. Anselme, J. P. Duguet, and J. Mallevialle.
IN: Aquatic Humic Substances: Influence on Fate and Treatment of Pollutants. American Chemical Society, Washington, DC. 1989. p 93-105, 6 fig, 3 tab, 15 ref.

Descriptors: *Water treatment, *Humic acids, *Drinking water, *Chromatography, Fulvic acids, Organic compounds, Clarification, Raw water.

Nonspecific parameters such as dissolved organic carbon, UV absorbance, and fluorescence are no longer sufficient to optimize new water-treatment processes. Specific determinations with gas or liquid chromatographic techniques identify only 5-15% of the dissolved organic carbon present in raw waters. The remaining high-molecular-weight compounds are still poorly characterized. A pyrolysis-gas chromatographic-mass spectrometric technique has been developed to study the background organic matrix of natural waters. Application to various soil and fresh-water samples indicates wide variations in the relative contributions of carbohydrates, polyhydroxy-aromatic substances, amino sugars, and proteinaceous materials to the high-molecular-weight fraction. Possible consequences for water-treatment processes are examined. The change of concentration of these biopolymers during a clarification process is also reported. (See W90-01491) (Author's abstract)
W90-01498

**EFFECTS OF HUMIC SUBSTANCES ON METAL SPECIATION.**
Georgia Inst. of Tech., Atlanta. School of Geophysical Sciences.
E. M. Perdue.
IN: Aquatic Humic Substances: Influence on Fate and Treatment of Pollutants. American Chemical Society, Washington, DC. 1989. p 281-295, 3 fig, 2 tab, 22 ref.

Descriptors: *Water treatment, *Water pollution effects, *Humic acids, *Metals, Speciation, Hydrogen ion concentration, Thermodynamics.

Some of the problems that must be understood and solved before the effects of metal-humic substance complexation on water-treatment processes can be quantitatively addressed are considered. The heterogeneity of ligands in a humic substance not only complicates the mathematical description of equilibrium data, but also makes the complexation capacity of a humic substance almost impossible to determine accurately. Complexation capacities (meq/g) of humic substances are widely reported to vary with pH, ionic strength, concentration of the humic substance used in the measurement, and nature of the metal being studied. By analogy with the behavior of a simple ligand (citrate), it is demonstrated that the reported effect of humic-substance concentration on complexation capacity is probably an artifact and that other experimental parameters affect conditional concentration quotients for metal complexation reactions. These effects create the illusion that complexation capacity is a function of pH, ionic strength, and nature of the added metal ion. (See also W90-01491) (Author's abstract)
W90-01510

**COAGULATION PROCESS FOR REMOVAL OF HUMIC SUBSTANCES FROM DRINKING WATER.**
Aquateam-Norwegian Water Technology Centre of Oslo (Norway).
W. A. Vik, and B. Eikebrokk.
IN: Aquatic Humic Substances: Influence on Fate and Treatment of Pollutants. American Chemical Society, Washington, DC. 1989. p 385-408, 10 fig, 76 ref.

Descriptors: *Water treatment, *Coagulation, *Humic acids, *Drinking water, Odor control, Chemical precipitation, Water pollution effects, Water distribution, Taste, Organoleptic properties, Aluminum sulfate, Polyelectrolytes, Disinfection, Filtration, Corrosion control.

Humic substances adversely affect the quality of drinking water in many ways. For instance, they impart color, serve as precursors to the formation of chlorinated compounds, possess ion-exchange and complexing properties that include association with toxic elements and micropollutants, and precipitate in distribution systems. The coagulation process, in which aluminum sulfate is the most commonly used coagulant aid, along with ferric salts and some organic polyelectrolytes, is reviewed. Aluminum chemistry and coagulation mechanisms are reviewed in detail. Factors that are critical to the design of processes, such as the importance of the rapid-mixing process, are discussed. The results of several recent studies on conventional and direct filtration treatment are given. These results illustrate, from an operational perspective, the chemical theory that is presented. In spite of the development of new separation techniques for water treatment, the coagulation process will continue to be the most important water-treatment process worldwide for removal of humic substances. Further research is needed to improve the coagulation process, optimize coagulant dose, minimize residual aluminum, and integrate separation, disinfection, taste-, odor-, and corrosion-control treatment into the water-treatment program. (See also W90-01491) (Author's abstract)
W90-01515

**REACTIONS BETWEEN FULVIC ACID AND ALUMINUM: EFFECTS ON THE COAGULATION PROCESS.**
Pennsylvania State Univ., University Park. Dept. of Civil Engineering.
B. A. Dempsey.
IN: Aquatic Humic Substances: Influence on Fate and Treatment of Pollutants. American Chemical Society, Washington, DC. 1989. p 409-424, 6 fig, 1 tab. 43 ref.

Descriptors: *Water treatment, *Coagulation, *Fulvic acids, *Aluminum sulfate, *Alum, Speciation, Colorimetry, Adsorption, Chemical precipitation, Hydrogen ion concentration.

The effects of fulvic acids on the speciation of aluminum were measured by timed colorimetric analyses. Precipitates of Al(OH)3 (pKsp = 32.8 for pH 4.5-6.5) form in every region where alum has been shown to be successful for the removal of fulvic acids. Stability functions (average log) K = 3.39) are reported for the formation of soluble aluminum-fulvic acid complexes. Adsorption functions (fulvic acid on freshly precipitated Al(OH)3 are more than 10 times larger than the stability functions for complexation of fulvic acids with dissolved aluminum. (See also W90-01491) (Author's abstract)
W90-01516

**ALUMINUM AND IRON(III) CHEMISTRY: SOME IMPLICATIONS FOR ORGANIC SUBSTANCE REMOVAL.**
Centre National de la Recherche Scientifique, Vandoeuvre-les-Nancy (France). Equipe de Recherche sur la Coagulation-Floculation.
J. Y. Bottero, and J. L. Bersillon.
IN: Aquatic Humic Substances: Influence on Fate and Treatment of Pollutants. American Chemical Society, Washington, DC. 1989. p 425-442, 13 fig, 3 tab., 54 ref.

Descriptors: *Water treatment, *Coagulation, *Flocculation, *Humic acids, *Fulvic acids, *Organic compounds, Hydrogen ion concentration, Aluminum, Iron, Chemical precipitation, Adsorption, Polycations, Raw water.

Removal of organic substances by metallic salts is one of the most important processes in the water-treatment industry. Some of the subsequent treatment phases depend on the efficiency of the coagulation-flocculation phase. Development of new coagulant-flocculant agents is one way to improve the removal of organic compounds by coagulation.

A new generation of aluminum and iron hydroxides is being developed by prehydrolyzing aluminum or iron chloride salts to form active species. These polymers have greater reactivity than alum in removing organic material when the solution pH is lower or higher than the sweep flocculation zone. In acidic solutions (pH <5.5-6) coagulation-flocculation is achieved by charge neutralization of organic acid functions, followed by precipitation. Removal is achieved at pH >6.5 by adsorption onto large particles. The polycations are stable over pH and time. Their structure is open and loose (fractal), ensuring a large available surface area for complexing or adsorbing molecules. The stability constants of organic compound--Al polycation complexes are higher than the stability constants of organic compound--Al or Fe monomer complexes. Prehydrolyzed coagulant-flocculant agents can be designed to adapt the treatment to specific raw-water characteristics. (See also W90-01491) (Author's abstract)
W90-01517

**EFFECTS OF HUMIC SUBSTANCES ON PARTICLE FORMATION, GROWTH, AND REMOVAL DURING COAGULATION.**
Arizona Univ., Tucson. Dept. of Civil Engineering.
G. L. Amy, M. R. Collins, C. J. Kuo, Z. K. Chowdhury, and R. C. Bales.
IN: Aquatic Humic Substances: Influence on Fate and Treatment of Pollutants. American Chemical Society, Washington, DC. 1989. p 443-452, 1 fig, 2 tab, 16 ref. US Environmental Protection Agency Grant R-812325-01-0.

Descriptors: *Water treatment, *Humic acids, *Coagulation, *Aluminum sulfate, Hydrogen ion concentration, Raw water, Grasse River, Edisto River.

Research was conducted to examine (1) the effect of natural organic matter (NOM) on the formation, growth, and removal of particles during coagulation using aluminum sulfate and (2) the effect of particles on NOM removal. Several sources of NOM and several types of mineral particles were studied under water treatment conditions using water from the Grasse River in New York and the Edisto River in South Carolina. Particle formation, growth, and removal were found to be significantly affected by initial particle type and concentration, NOM type and concentration, pH, and aluminum sulfate dose. (See also W90-01491) (Author's abstract)
W90-01518

**CHARACTERISTICS OF HUMIC SUBSTANCES AND THEIR REMOVAL BEHAVIOR IN WATER TREATMENT.**
Georgia Inst. of Tech., Atlanta. School of Civil Engineering.
J. S. Kim, E. S. K. Chian, F. M. Saunders, E. M. Perdue, and M. F. Giabbai.
IN: Aquatic Humic Substances: Influence on Fate and Treatment of Pollutants. American Chemical Society, Washington, DC. 1989. p 473-497, 14 fig, 3 tab, 33 ref.

Descriptors: *Water treatment, *Humic acids, *Organic matter, *Coagulation, Alum, Aluminum sulfate, Turbidity, Trihalomethanes, Color removal, Chattahoochee River, Raw water.

The characteristics of naturally occurring aquatic humic substances and their removal behavior in water treatment were investigated in a plant operation and in alum coagulation with conventional laboratory jar-test experiments using raw water from the Chattahoochee River in Georgia. Specific characteristics of humic substances affected the performance of alum coagulation in removing both humic substances and turbidity. Up to 50% of the humic substances were removed in both the treatment plant and alum coagulation. High-molecular-weight humic substances were preferentially removed. This preference resulted in substantial decreases in color intensity and trihalomethane formation potential per unit mass of humic substances. The characteristics and removal behavior by alum coagulation of commercial humic acid were significantly different from those of the source-water humic substances. (See also W90-01491) (Author's abstract)
W90-01520

**EFFECTS OF HUMIC BACKGROUND ON GRANULAR ACTIVATED CARBON TREATMENT EFFICIENCY.**
Michigan Univ., Ann Arbor. Dept. of Environmental and Water Resources Engineering.
W. J. Weber, and E. H. Smith.
IN: Aquatic Humic Substances: Influence on Fate and Treatment of Pollutants. American Chemical Society, Washington, DC. 1989. p 501-532, 22 fig, 9 tab, 28 ref. National Science Foundation Award No. CEE-8112945.

Descriptors: *Water treatment, *Wastewater treatment, *Mathematical models, *Humic acids, *Activated carbon, *Model studies, Fulvic acids, Organic carbon, Adsorption.

Uncharacterized background organic matter can impair the effectiveness and complicate the design and operation of adsorption treatment processes directed at the removal of specific target organic compounds from waters and wastewaters. Mathematical models calibrated with system-specific information may facilitate process design and operation by allowing quantification of the effects of such background matter on adsorption efficiency. A two-resistance homogeneous surface diffusion adsorption model was used to simulate and predict fixed-bed adsorber breakthrough behavior for two specific solutes in background waters from various sources. Independent measurements of requisite model coefficients were made for the two target solutes directly in the presence of the background organic matter, which in turn was treated as an unspecified class of components quantified only in terms of the lumped analytical parameter of total organic carbon. This approach suitably incorporated the effects of the background matter in model forecasts of fixed-bed adsorber performance for the target compounds. (See also W90-01491) (Author's abstract)
W90-01521

**FRONTAL CHROMATOGRAPHIC CONCEPTS TO STUDY COMPETITIVE ADSORPTION: HUMIC SUBSTANCES AND HALOGENATED ORGANIC SUBSTANCES IN DRINKING WATER.**
Drexel Univ., Philadelphia, PA. Environmental Studies Inst.
R. J. Baker, I. H. Suffet, and T. L. Yohe.
IN: Aquatic Humic Substances: Influence on Fate and Treatment of Pollutants. American Chemical Society, Washington, DC. 1989. p 533-548, 9 fig, 2 tab, 1 chart, 22 ref.

Descriptors: *Water analysis, *Chemical analysis, *Water treatment, *Activated carbon, *Humic acids, *Drinking water, *Chromatography, Trihalomethanes, Chlorinated hydrocarbons, Statistical analysis, Adsorption, Pilot plants.

Frontal chromatographic theory is used to describe the breakthrough of solutes in granular activated carbon (GAC). Depletion of adsorption sites during use of GAC contactors can be expressed in terms of changes in moving concentration profiles, or fronts. These fronts can be defined in chromatographic terms. Data from a pilot-scale carbon adsorption study are used as an example of how frontal chromatographic theory can be applied. Current models for describing and predicting solute breakthrough from GAC columns cannot predict breakthrough of a wide variety of compounds under water-treatment conditions. Frontal chromatography theory is useful for understanding the displacement and breakthrough phenomena in carbon contactors. (See also W90-01491) (Author's abstract)
W90-01522

**ADSORPTION OF MICROPOLLUTANTS ON ACTIVATED CARBON.**
University of Southern California, Los Angeles. Dept. of Civil Engineering.
M. Pirbazari, V. Ravindran, S. Wong, and M. R. Stevens.
IN: Aquatic Humic Substances: Influence on Fate and Treatment of Pollutants. American Chemical Society, Washington, DC. 1989. p 549-578, 11 fig, 2 tab, 44 ref.

Descriptors: *Humic acids, *Activated carbon, *Water treatment, *Adsorption, *Wastewater treatment, *Model studies, Chlorinated hydrocarbons, Polychlorinated biphenyls, Dissolved solids, Organic carbon, Chloroform, Solubility, IAST model.

The effect of humic substances (HS) on the activated-carbon adsorption of several contaminants, including trichloroethylene, chloroform, geosmin, and polychlorinated biphenyls was studied. Complexation potentials of these compounds with HS were investigated to determine the extent of their association. Adsorption experiments performed included equilibrium, minicolumn, and high-pressure minicolumn studies. The ideal adsorbed solution theory (IAST) model was employed to predict adsorption equilibria of mixtures containing each pollutant and HS from their single-solute isotherms. The theoretical predictions obtained from the model were in good agreement with the experimental results. The reduction in adsorption capacity attributed to preloading of carbon with HS was substantial for chloroform, but marginal for polychlorinated biphenyls. (See also W90-01491) (Author's abstract)
W90-01523

**ACTIVATED-CARBON ADSORPTION OF ORGANIC POLLUTANTS.**
Karlsruhe Univ. (Germany, F.R.). Engler-Bunte Inst.
G. Zimmer, H. Brauch, and H. Sontheimer.
IN: Aquatic Humic Substances: Influence on Fate and Treatment of Pollutants. American Chemical Society, Washington, DC. 1989. P 579-596, 14 fig, 1 tab, 19 ref.

Descriptors: *Water treatment, *Activated carbon, *Humic acids, *Adsorption, Drinking water, Organic matter, Hydrogen ion effects, Ozonation, Chlorinated hydrocarbons, Lake Constance, Rhine River, Hohloh Lake.

Interaction with organic background substances is important in the removal of micropollutants by adsorption during water treatment. Adsorption analysis characterizes the organic matter in drinking water by adsorbability. This approach was applied in a comparison of varying humic substances and water-treatment processes using water from Lake Constance (Bodensee), Hohloh Lake, and the Rhine River. pH effects were also investigated. The influence of very low concentrations of natural organic matter on the removal of halogenated pollutants was investigated. Organic background significantly affects the range of adsorption capacities for a particular compound between different activated carbons. The main effect could be caused by the slow kinetic properties of humic substances and a long-term preloading of the carbon in a column. Despite different water sources, organic-matter concentrations, and activated-carbon types, a single relationship was found for the maximum column capacities of a halogenated pollutant. The impact of humic substances is a general reduction of the carbon capacity, which can be adequately described by diminishing of the Freundlich parameter, K. With this time dependency, the breakthrough of micropollutants in treatment plants can be calculated. (See also W90-01491) (Peters-PTT)
W90-01524

**TRIHALOMETHANE PRECURSOR AND TOTAL ORGANIC CARBON REMOVAL BY CONVENTIONAL TREATMENT AND CARBON.**
Environmental Protection Agency, Cincinnati, OH. Drinking Water Research Div.
B. W. Lykins, and R. M. Clark.
IN: Aquatic Humic Substances: Influence on FAte and Treatment of Pollutants. American Chemical

Society, Washington, DC. 1989. p 597-621, 15 fig, 5 tab, 12 ref.

Descriptors: *Water treatment, *Organic carbon, *Activated carbon, *Trihalomethanes, Coagulation, Flocculation, Sedimentation, Filtration.

Data from four water-treatment plants (Cincinnati, Ohio; Jefferson Parish, Louisiana; Manchester, New Hampshire; and Evansville, Indiana) were used to describe the performance of conventional treatment and granular activated carbon for removing trihalomethane precursors to meet various treatment goals. Also presented are data for total organic carbon removal, which has been suggested as an organic surrogate for measuring the effectiveness of water treatment. Conventional treatment (coagulation, flocculation, sedimentation, and filtration), as used in the four water-treatment plants evaluated, substantially reduced total organic carbon and trihalomethane precursor concentrations. Granular activated carbon may be a treatment alternative to consider for meeting trihalomethane standards as low as 50 micrograms/L. (See also W90-01491) (Author's abstract)
W90-01525

**FATE AND REMOVAL OF RADIOACTIVE IODINE IN THE AQUATIC ENVIRONMENT.**
Karlsruhe Univ. (Germany, F.R.). Engler-Bunte Inst.
R. S. Summers, F. Fuchs, and H. Sontheimer.
IN: Aquatic Humic Substances: Influence on Fate and Treatment of Pollutants. American Chemical Society, Washington, DC. 1989. p 623-636, 9 fig, 8 tab, 12 ref.

Descriptors: *Water treatment, *Path of pollutants, *Humic acids, *Iodine radioisotopes, *Radioactive wastes, Drinking water, Rhine River, Kinetics, Hydrogen ion concentration, Flocculation, Activated carbon, Adsorption, Organic carbon, Dissolved solids.

The reaction of iodine with aquatic humic substances (HS) and the subsequent removal of the products by typical drinking-water-treatment processes was investigated. Both iodine and iodide react completely with isolated HS in the concentration range below 0.03 mg of I per mg of HS and behave similarly with Rhine River water. The reaction is independent of pH, initial HS concentration, and HS molecular size. However, at higher I-HS ratios iodine reacts slightly more than iodide. Kinetic studies indicate that the reaction is complete within 10 min. No interaction was found between methyl iodide and HS. Flocculation and activated-carbon (AC) adsorption were effective for the removal of the I-HS complex, and the dissolved organic carbon measurement served as a good surrogate parameter. Volatilization and AC adsorption were effective for methyl iodide removal. (See also W90-01491) (Author's abstract)
W90-01526

**EFFECT OF OZONATION AND CHLORINATION ON HUMIC SUBSTANCES IN WATER.**
Kiwa Ltd., P.O. Box 1072, 3430 BB Nieuwegein, Netherlands.
J. C. Kruithof, M. A. van der Gaag, and D. van der Kooy.
IN: Aquatic Humic Substances: Influence on Fate and Treatment of Pollutants. American Chemical Society, Washington, DC. 1989. P 663-680, 14 fig, 2 tab, 19 ref.

Descriptors: *Water treatment, *Humic acids, *Ozonation, *Chlorination, *Trihalomethanes, Coagulation, Filtration, Organic carbon, Dissolved solids, Mutagenicity, Drinking water.

Ozonation converts humic substances, as can be seen by a small decrease in dissolved organic carbon (DOC) and a substantial decrease in UV extinction. This conversion is related to the formation of low-molecular-weight biodegradable compounds, which enhance regrowth of organic substances in water during distribution. Post-treatment by coagulation and filtration processes can remove these types of compounds. Chlorination of humic substances causes the production of trihalomethanes (THMs), high-molecular-weight organohalides, and mutagenicity. A partial THM-precursor removal by pretreatment does not reduce the THM content under practical conditions and causes a shift to production of more highly brominated THMs. Extensive pretreatment with ozonation and granular activated carbon (GAC) filtration lowers the adsorbable organohalogen (AOX) content and the mutagenic activity in the Ames test. (See also W90-01491) (Author's abstract)
W90-01528

**CHLORINATED HUMIC ACID MIXTURES: CRITERIA FOR DETECTION OF DISINFECTION BYPRODUCTS IN DRINKING WATER.**
Environmental Protection Agency, Cincinnati, OH. Drinking Water Research Div.
A. A. Stevens, L. A. Moore, C. J. Slocum, B. L. Smith, and D. R. Seeger.
IN: Aquatic Humic Substances: Influence on Fate and Treatment of Pollutants. American Chemical Society, Washington, DC. 1989. p 681-695, 1 fig, 2 tab, 25 ref.

Descriptors: *Water analysis, *Pollutant identification, *Water treatment, *Drinking water, *Humic acids, *Chlorinated humic acids, *Chlorination, Byproducts, Chromatography, Spectroscopy.

The feasibility of using a chlorinated humic acid byproduct data base, developed in-house, as a drinking water quality screening tool is discussed. Specifically, a gas chromatographic-mass spectral (GC-MS) data base of more than 780 compounds identified during experiments involving the reaction of humic acids with chlorine has been compiled and systematically compared to GC-MS profiles from extracts of finished drinking water sampled from 10 preselected operating utilities. A major goal of the research was to narrow this library down to a smaller, more significant target compound list that would be representative of the chlorination byproducts most frequently encountered in the finished drinking water of utilities practicing chlorine disinfection. The study also demonstrates the practicality of using the described methodology for concentrating and identifying specific compounds from water samples at low concentrations. (See also W90-01491) (Author's abstract)
W90-01529

**REMOVAL OF AQUATIC HUMUS BY OZONATION AND ACTIVATED-CARBON ADSORPTION.**
Norges Tekniske Hoegskole, Trondheim. Dept. of Civil Engineering.
E. Kaastrup, and T. M. Halmo.
IN: Aquatic Humic Substances: Influence on Fate and Treatment of Pollutants. American Chemical Society, Washington, DC. 1989. p 697-726, 22 fig, 5 tab, 25 ref.

Descriptors: *Ozonation, *Activated carbon, *Water treatment, *Humic acids, Norway, Color removal, Dissolved solids, Organic carbon, Pilot plants, Isotherms, Adsorption.

The separate and combined effects of treatment with ozone and activated carbon were studied for three different humus sources: Norwegian brook water, Norwegian bog water, and commercial humic acid. The effect of ozonation on solution properties was determined by ultrafiltration, color, UV, and dissolved organic carbon (DOC) analysis. Adsorption prior to and after ozonation was studied in laboratory isotherm studies and a pilot-scale column experiment. Ozonation caused significant reductions in the content of high-molecular-weight material, UV extinction, and color; DOC reductions were insignificant for $<1$ mg of ozone per mg of DOC. Both isotherm and pilot-scale studies showed significant increases in adsorption capacities resulting from preozonation. (See also W90-01491) (Author's abstract)
W90-01530

**EFFECT OF COAGULATION, OZONATION, AND BIODEGRADATION ON ACTIVATED-CARBON ADSORPTION.**
North Carolina Univ., Chapel Hill. Dept. of Economics.
G. W. Harrington, F. A. DiGiano, and J. Fettig.
IN: Aquatic Humic Substances: Influence on Fate and Treatment of Pollutants. American Chemical Society, Washington, DC. 1989. p 727-746, 6 fig, 5 tab, 9 ref. U.S. Environmental Protection Agency's Exploratory Research Program Grant No. R811824.

Descriptors: *Water treatment, *Humic acids, *Coagulation, *Activated carbon, *Ozonation, *Biodegradation, *Model studies, Adsorption, IAST model, Kinetics, Alum, Aluminum sulfate, Organic compounds, Mathematical models.

The ability to describe humic substance (HS) adsorption is important for the design of activated-carbon filters in water treatment. Humic solutions are composed of a multitude of unknown molecular species, and competitive adsorption among these species, as well as with trace anthropogenic organic chemicals, needs to be understood better. Ideal adsorbed solution theory was used to describe an aquatic humic solution as a set of several pseudocomponets and to evaluate the effects of two treatment processes (alum coagulation and a combination of coagulation, ozonation, and biodegradation) on the solution's equilibrium and kinetic adsorption behavior. Coagulation improved the adsorbability of the HS mixture by changing its composition, as well as by decreasing its initial concentration. After ozonation and biodegradation, the HS mixture showed no significant changes from the coagulated mixture in terms of adsorption equilibrium behavior. There, since ozonation is thought to reduce adsorbability because of the production of polar organic species, biodegradation must remove these compounds to yield the observed results. (See also W90-01491) (Peters-PTT)
W90-01531

**EFFECTS OF HUMIC SUBSTANCES ON MEMBRANE PROCESSES.**
Centre de Recherche Lyonnaise des Eaux - Degremont, Le Pecq (France).
J. Mallevialle, C. Anselme, and O. Marsigny.
IN: Aquatic Humic Substances: Influence on Fate and Treatment of Pollutants. American Chemical Society, Washington, DC. 1989. p 749-767, 14 fig, 3 tab, 10 ref.

Descriptors: *Water treatment, *Membrane processes, *Water analysis, *Humic acids, Organic matter, Membranes, Chromatography, Spectroscopy, Electron microscopy, Filtration.

Analytical methods are being developed to help characterize the mechanism of membrane fouling in water treatment processes. For example, pyrolysis-gas chromatography-mass spectrometry provides a global information on the nature of macromolecules present in the water and in the cake that forms at the membrane surface. Scanning electron microscopy, transmission electron microscopy, elemental analysis, X-ray microanalysis, secondary ion mass spectroscopy, and Fourier transform IR spectroscopy also can be used to define the encrustation. The results show that fouling can be linked to the organic matrix, and especially to carbohydrates, proteins, and polyhydroxyaromatic compounds. (See also W90-01491) (Peters-PTT)
W90-01532

**REMOVAL OF HUMIC SUBSTANCES BY MEMBRANE PROCESSES.**
Norges Tekniske Hoegskole, Trondheim. Div. of Hydraulic and Sanitary Engineering.
H. Odegaard, and T. Thorsen.
IN: Aquatic Humic Substances: Influence on Fate and Treatment of Pollutants. American Chemical Society, Washington, DC. 1989. p 769-782, 6 fig, 5 tab, 6 ref.

Descriptors: *Water treatment, *Membrane processes, *Cellulose acetate membranes, *Humic acids, Color removal, Pilot plants, Laboratory studies.

Both laboratory and pilot-plant experiments have been carried out to evaluate the use of membrane processes for the removal of humic substances. These processes are competitive for small waterworks with high raw-water color. Cellulose acetate membranes with a molecular weight (MW) cutoff of 800-1000 may be used favorably at a pressure of 7-10 bars. The capacity of the membrane will be reduced, even when optimal membrane washing is performed. The washing solution should be citric acid, sodium citrate, and sodium alkylaryl sulfonate. The long-term capacity of the spiral-wound cellulose acetate membrane was found to be 25 L/sq m.h at optimal membrane washing. The lifetime of a membrane at this capacity is estimated as 4 years. (See also W90-01491) (Author's abstract)
W90-01533

**DISSOLVED ORGANIC COMPONENTS IN PROCESS WATER AT THE LOS BANOS DESALTING FACILITY.**
California Univ., Los Angeles. School of Engineering and Applied Science.
For primary bibliographic entry see Field 5D.
W90-01534

**MECHANISTIC INTERACTIONS OF AQUATIC ORGANIC SUBSTANCES WITH ANION-EXCHANGE RESINS.**
Camp, Dresser and McKee, Inc., Fort Lauderdale, FL.
P. L. K. Fu, and J. M. Symons.
IN: Aquatic Humic Substances: Influence on Fate and Treatment of Pollutants. American Chemical Society, Washington, DC. 1989. p 797-811, 7 fig, 4 tab, 13 ref. U.S. Environmental Protection Agency, Office of Research and Development Grant No. R-812155-01-0.

Descriptors: *Water treatment, *Humic acids, *Anion exchange, *Organic matter, *Resins, Reverse osmosis, Organic carbon, Ion exchange, Drinking water.

Specific interactions of aquatic organic substances isolated from a natural water source on commercial anion-exchange resins were investigated. The mechanisms of organic removal and the influences of resin properties on the removal were studied. The organic compounds used were concentrated by reverse osmosis and then separated by ultrafiltration into four molecular size fractions. Each organic fraction was characterized for organic carbon and carboxyl contents. Specific interactions of the organic fractions on various types of anion-exchange resins were studied by batch equilibrium experiments. Results indicate that about 90% of the dissolved organic carbon recovered from the natural water was removable by anion-exchange resins via an ion-exchange mechanism, and that both skeletal and pore structures were important to the removal, depending on the characteristics of the organic substances. (See also W90-01491) (Author's abstract)
W90-01535

**REMOVAL OF HUMIC SUBSTANCES BY ION EXCHANGE.**
Norges Tekniske Hoegskole, Trondheim. Div. of Hydraulic and Sanitary Engineering.
H. Odegaard, H. Brattebo, and O. Halle.
IN: Aquatic Humic Substances: Influence on Fate and Treatment of Pollutants. American Chemical Society, Washington, DC. 1989. p 813-834, 13 fig, 5 tab, 17 ref.

Descriptors: *Water treatment, *Humic acids, *Ion exchange, *Resins, Kinetics, Sorption.

Results from a research program in which ion exchange has been evaluated as an alternative process for removal of humic substances, especially at small waterworks are presented. It has been demonstrated that ion exchange in a strong-base, anionic, macroporous resin is economically competitive with other alternatives when the raw-water humic-substance concentration is relatively low (<50 mg of Pt/L or 5 mg of total organic carbon/L). Such resins have a good capacity, but the sorption kinetics are relatively slow because of the slow diffusion of the humic molecules. The process should be carefully designed. Empty-bed contact time is the most important design parameter, and a countercurrent beds-in-series design should be used. Design criteria for the process and for regeneration are given. (See also W90-01491) (Author's abstract)
W90-01536

**CHARACTERIZATION OF THE RIVER AND DRINKING WATER QUALITY OF A GREAT CITY.**
Timisoara Water Board (Romania).
For primary bibliographic entry see Field 5G.
W90-01628

**URBAN WATER SUPPLY IN ARID ENVIRONMENT-EXAMPLES FROM THE ARABIAN PENINSULA.**
Dornier-System G.m.b.H., Friedrichshafen (Germany, F.R.). Dept. for Regional and Environmental Planning.
H. Neuland.
IN: Hydrological Processes and Water Management in Urban Areas. Proceedings of the International Symposium 24-29 April 1988, Duisburg, West Germany. International Hydrological Programme of UNESCO Publication, 1988. p 153-160, 1 fig, 3 tab, 5 ref.

Descriptors: *Urban areas, *Arid climates, *Water supply, *Water resources development, Desalination, Saudi Arabia, Groundwater budget, Riyadh, Jeddah.

This paper discusses the conflict between urban water supply and agricultural development, to achieve a prudent level of self-sufficiency in essential foodstuffs. Agricultural water supplies in Saudi Arabia, originate exclusively from non-renewable groundwater resources which should be conserved for drinking water purposes instead of producing desalinated sea water at very high cost. Heavy groundwater exploitation (i.e., declining water levels and deteriorating water quality) constitute a burden on the national economy additional to the desalination of sea water. Two examples of urban water supply in arid environments are discussed: the cities of Riyadh and Jeddah. While water supply in Riyadh could rely on groundwater, Jeddah has to be supplied be desalinated water. In both cases recycled wastewater should be considered for further use. (See also W90-01612)(Author's abstract)
W90-01629

**WATER SUPPLY FROM THE WESTERN GERMAN NAVIGATION CANALS.**
Wasserverband Westdeutsche Kanale, Essen (Germany, F.R.).
J. Ruppert.
IN: Hydrological Processes and Water Management in Urban Areas. Proceedings of the International Symposium 24-29 April 1988, Duisburg, West Germany. International Hydrological Programme of UNESCO Publication, 1988. p 161-168, 4 fig.

Descriptors: *West Germany, *Costs, *Water resources development, *Water supply, Navigation canals, Ruhr River, Rhein River, Lippe River, Water quality.

In a highly industrialized and densely populated region navigation canals make possible the transport of bulk goods by ship and at the same time supply water for industrial use. The Dortmund-Ems-Kanal (1898) connects West German industrial region with the German North Sea coast, the Rhein-Herne-Kanal (1914) and the Wesel-Datteln-Kanal (1931) connect the area with the Rhein River, and the Datteln-Hamm-Kanal (1914) also ties on the eastern part of the Ruhr district to the system. The canals are mainly built for traffic by motor ships with up to 1,350 tons of loading capacity; some parts are still being developed for this purpose. Wastewater discharged into the canals is avoided as far as possible. Therefore, the water quality is so good that it can be used indirectly for drinking water; in the region of Munster and in dry periods near Haltern, canal water is used for groundwater recharge. Reservoirs for the storage of water for dry periods in the upper catchment area were not possible for geological reasons. So, pumping plants were built at the navigation locks to satisfy the water need of the canals. The plants can haul the water, which is missing from the Lippe, from the Ruhr or directly from the Rhein. In 1907, the State founded the Association 'Wasserverband Westdeutsche Kanale' to safeguard the rights and obligations under the agreement of 1968. The essential tasks of this association are the financing of pumping plants and managing of water for the industrial water supply from the canals. Financing is ensured through contributions of the members of the association. The amount of the respective contribution is determined by the water demand of each member. The settlement of accounts for the volumes of industrial water withdrawn with the Waterway and Navigation Administration is made each month on the basis of a mixed price, which is formed by the costs of the transfer of Lippe water and the costs of the pumping of Ruhr or Rhein water. This is based on the daily notes of the members checked by random test by the association. The shares of the members are computed every year dependent on their notified water need and the real draw off of water. They are usually paid by the members in monthly installments. (See also W90-01612)(Lantz-PTT)
W90-01630

**STORAGE RESERVOIRS FOR WATER SUPPLY OF ECOLOGICAL IMPORTANCE.**
Gelsenwasser A.G., Gelsenkirchen (Germany, F.R.).
W. D. Schmidt.
IN: Hydrological Processes and Water Management in Urban Areas. Proceedings of the International Symposium 24-29 April 1988, Duisburg, West Germany. International Hydrological Programme of UNESCO Publication, 1988. p 177-184, 16 fig, 3 ref.

Descriptors: *Water storage, *Reservoir storage, *Ecosystems, *Recreation, Water supply, Rhine River, Lake Haltern, Hullern Reservoir, Ecological effects.

The storage reservoirs of Haltern and Hullern are the nearest recreation areas for the urban population at the Northern periphery of the industrial region situated on the right of the Rhine River. In connection with the date of creation of these reservoirs, their use for leisure time activities is different: 'noisy' recreation with water sports on the Haltern Lake and 'quiet' recreation without sports at the Hullern reservoirs. Flora and fauna naturally could better develop in the quiet region. The different leisure time uses of both reservoirs and their existing ecological situations are described in this paper. (See also W90-01612) (Author's abstract)
W90-01632

**SURFACE AND GROUND WATER USE IN THE URBAN AREA OF ZAGREB.**
S. Tedeschi.
IN: Hydrological Processes and Water Management in Urban Areas. Proceedings of the International Symposium 24-29 April 1988, Duisburg, West Germany. International Hydrological Programme of UNESCO Publication, 1988. p 185-192, 11 ref.

Descriptors: *Groundwater budget, *Surface water, *Water demand, *Zagreb, *Water quality control, Groundwater quality, Pump wells, Sava River, Hydrologic budget.

In the water supply of the city of Zagreb groundwater, which is renewed from the surface and through infiltration of the Sava River water, is used. Gradual growth of this urban area reduces the pumping well protection zones, periodically resulting in pollution of the pumping well. Water quality of the Sava River is deteriorating because of untreated wastewater discharges. Further use of both surface-water and groundwater calls for ex-

tensive remedial measures. (See also W90-01612) (Author's abstract)
W90-01633

**SEPARATE AND COMBINED SEWERS--EXPERIENCE IN FRANCE AND AUSTRALIA.**
New South Wales Inst. of Tech., Broadway (Australia).
M. G. Carleton.
IN: Hydrological Processes and Water Management in Urban Areas. Proceedings of the International Symposium 24-29 April 1988, Duisburg, West Germany. International Hydrological Programme of UNESCO Publication, 1988. p 205-212, 1 tab, 6 ref.

Descriptors: *Sewers, *Storm water, *Wastewater, *Water transport, *Water pollution control, France, Australia, Overflow, Water management.

Combined stormwater-sewer overflows have been found to be one of the major causes of receiving water pollution. The use of separate sewerage systems to solve pollution problems associated with combined systems is examined. Experiences in two countries which have predominantly one system or the other provided a basis for comparison. Wet weather overflows were found to be a major problem, with similar pollution loads produced, for both systems. Minimizing overflows was found to be possible; however, proper management of stormwater flows is indicated as the best solution. (See also W90-01612)(Author's abstract)
W90-01635

**WATER RENT AS AN ECONOMIC INSTRUMENT FOR THE PROTECTION AND IMPROVEMENT OF WATER QUALITY FOR THE BENEFIT OF THE DRINKING WATER SUPPLY OF TOWNS.**
Technische Hochschule Aachen (Germany, F.R.).
For primary bibliographic entry see Field 6C.
W90-01693

**WATER MANAGEMENT IN URBAN AREAS OF A DEVELOPING COUNTRY.**
Dar es Salaam Univ. (Tanzania). Dept. of Civil Engineering.
E. Gondwe.
IN: Hydrological Processes and Water Management in Urban Areas. Proceedings of the International Symposium 24-29 April 1988, Duisburg, West Germany. International Hydrological Programme of UNESCO Publication, 1988. p 735-740, 5 ref.

Descriptors: *Water management, *Urban areas, *Developing countries, Water quality management, Water supply development, Legislation, Tanzania, Dar es Salaam.

Attempts toward integrated management of water in urban areas have been made in some developing countries. In Tanzania, any center having a population greater than 5,000 people, and basic social services, is termed an urban center. The city of Dar es Salaam, Tanzania, on the coast of the Indian Ocean has an estimated population of about 1.5 million people, with an annual growth rate of about 5%. The city has frequently experienced interruptions to its water supply, and there is a lot of waste from the city's distribution system due to faulty valves and broken pipes. Rehabilitation and improvement of water services in the city would require exorbitant funds. Even though the government allocated about $1.5 million (US dollars) in early 1987 for the purchase of spare parts and other essential materials to solve these chronic water supply problems, it was still necessary to form an integrated management system for this urban water system to function efficiently. In Tanzania, a separate Ministry of Water was formed to work with the ministries of urban development and health, to control water quality. A special unit known as the Dar es Salaam Sewerage and Sanitation Department (DSSD), which was started in 1985 under the then Ministry of Lands, Water and Urban Development, has now been transferred to the new Ministry of Water. In 1981, Tanzania established the National Urban Water Supply (NUWA) by an Act of Parliament. NUWA, which is parastatal under the Ministry of Water, is expected to take responsibility of all urban water supply systems in Tanzania. But due to financial and technical reasons NUWA so far has been able to operate in Dar es Salaam only. Plans are underway to expand activities in NUWA to other towns in Tanzania. (See also W90-01612) (Lantz-PTT)
W90-01694

**ECOLOGICAL AND ECONOMICAL ADVANTAGES OF AN INTEGRATED WATER MANAGEMENT.**
Dortmund Univ. (Germany, F.R.). Inst. for Environmental Protection.
I. Heinz.
IN: Hydrological Processes and Water Management in Urban Areas. Proceedings of the International Symposium 24-29 April 1988, Duisburg, West Germany. International Hydrological Programme of UNESCO Publication, 1988. p 741-748, 1 tab, 2 ref.

Descriptors: *Water management, *Ecological effects, *Management planning, Economic aspects, Costs, Water law, West Germany, Legislation.

From an economic and ecological point of view, an integrated water management plan (the utilization of water resources while at the same time taking the demands of water supply, environmental protection, and city and land planning into account) is advantageous. This pre-supposes that the utilization of water resources is located close to consumption areas. This can be achieved by an intensification of water saving production methods, the redistribution of water rights, and a reversal of industrial water supply from groundwater to surface water resources. In order to practically enforce integrated water management, convenient regulating instruments are required. Existing laws on water and environment planning in West Germany, contain a number of regulations which are aimed at efficient water utilization. But these have to be sufficiently improved by amendments. The advantages of cost distributions can be seen with the possibility of regionally differentiating the amount of fees charged for water according to the type and quality of local water resources, and the cost of water resources development. Among the advantages of this kind of management are: (1) the careful treatment of high quality water resources; (2) the maintenance of ecological open spaces; and (3) the avoidance of encroachments on natural spaces worth being protected. (See also W90-01612) (Lantz-PTT)
W90-01695

**STRATEGIES IN URBAN WATER DESIGN.**
Technische Hogeschool Delft (Netherlands). Dept. of Architecture and Urban Regional Planning.
For primary bibliographic entry see Field 6A.
W90-01701

**PERFORMANCE OF AIR STRIPPING AND GAO FOR SOC AND VOC REMOVAL FROM GROUNDWATER.**
Michigan Technological Univ., Houghton.
D. W. Hand, J. C. Crittenden, J. M. Miller, and J. L. Gehin.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-110274. Price codes: A04 in paper copy, A01 in microfiche. Report No. EPA/600/2-88/053, September 1988. 80p, 52 fig, 177 tab, 41 ref. EPA Contract CR 811150.

Descriptors: *Granular activated carbon, *Water treatment, *Volatile organic compounds, *Groundwater pollution, Synthetic compounds, Costs, Economic aspects, Dichloroethene, Trichloroethene, Air stripping, Tetrachloroethene, Toluene, Organic compounds, Chemical treatment.

This study compares the ability and cost-effectiveness of granular activated carbon (GAC) and packed tower aeration (air stripping) in removing synthetic organic and volatile organic chemicals (SOCs and VOCs) from a contaminated groundwater source in Wausau, WI. Among the SOCs and VOCs identified and targeted from removal were cis-1,2-dichloroethene, trichloroethene, tetrachloroethene, and toluene. A liquid-phase GAC adsorber, and a full-scale air stripping tower were designed, built, and operated to provide data so that the process performance could be evaluated. Extensive laboratory studies that included: (1) single solute and multicomponent isotherms; (2) batch rate experiments; (3) mini-column experiments; (4) rapid small scale column tests; were performed. Mathematical models and correlations for obtaining kinetic parameters and single solute isotherm parameters were developed and tested by comparing their results to those obtained from the pilot plant. Possible surrogate parameters such as total organic halogen, total organic carbon, trihalomethane formation potential, total organic halogen formation potential, and UV absorbance for use in monitoring GAC performance were investigated. Costs of an actual full-scale air stripping process designed for a minimum tower volume (lowest capital costs) and energy requirements (lowest operation and maintenance costs), and liquid-phase GAC fixed-bed processes designed from pilot-plant data are compared. (Author's abstract)
W90-01709

**BIOHAZARDS OF DRINKING WATER TREATMENT.**
121 South Main Street, Chelsea, MI 48118.
Biohazards of Drinking Water Treatment, Edited by Richard A. Larson. Lewis Publishers, Chelsea, MI, 1989. 293 pp.

Descriptors: *Drinking water, *Potable water, *Water treatment, *Public health, *Chlorination, *Ozonation, *Water quality control, Filtration, Organic compounds, Water quality, Human pathogens, Toxicity, Viruses, Bacteria.

The chapters in this book were first presented as papers at a symposium of the Environmental Chemistry Division of the American Chemical Society at its 194th national meeting, New Orleans, September 1987. The symposium called attention to the many problems that remain in trying to provide drinking water of good quality of the people of industrialized societies. An overview of public health risks related to drinking water treatment practices and the perception of these risk by users is presented in the opening section. The second section discusses chlorinated ethanes, volatile organic compounds that are becoming more frequently detected in contaminated source waters, especially groundwater. The sources of these chemicals and their fates during water treatment are not fully understood. In the book's third section, work on identifying waterborne viruses and other pathogenic organisms in treated drinking water is presented. The next section examines some of the chemical reactions between aqueous chlorine and common constituents of natural waters such as amino acids and humic materials. Some of the efforts that have gone into identifying especially active mutagens found in drinking water concentrates are described. The use of ozone as an alternative disinfectant is discussed in the fifth section of the book, and the book closes with several chapters on a variety of topics that represent advanced thinking about fundamental aspects of water treatment. Synthesis of new disinfectants and prevention of growth of undesirable organisms in drinking water are discussed. (See W90-01751 thru W90-01772)
W90-01750

**HEALTH RISK IN RELATION TO DRINKING WATER TREATMENT.**
Stichting Waterlaboratorium Oost, Doetinchem (Netherlands).
H. J. Kool.
IN: Biohazards of Drinking Water Treatment, Lewis Publishers, p 3-15, 1989. 12 fig, 1 tab, 65 ref.

Descriptors: *Drinking water, *Potable water, *Water treatment, *Public health, *Chlorination, *Risks, *Ozonation, The Netherlands, Water quality, Water quality control, Carcinogens, Chlorine.

Relative health risk in various modes of drinking water treatment in the Netherlands are reviewed. Chlorine dioxide and ozone are preferred over chlorine with respect to formation of mutagenic activity and organohalides in drinking water treatment. In contrast with chlorine, both treatments occasionally introduce or increase mutagenic activity depending on the type of water. For ozone, the process conditions are also an important factor. The production of organohalides by chlorine dioxide is substantially less than for chlorine. It seems that ozone decreases the level of organohalides (nonvolatiles). Evidence of carcinogenic effects of chorinated drinking water is rather weak. Recently, 'new' problems have shown up in the drinking water supply of The Netherlands, including the appearance of Aeromonas bacteria, and increased levels of nitrates due to high application rates of manure in areas with intensive husbandry. Application of denitrification processes in drinking water supply seems to be necessary in the future, most likely using sulfur/limestone filtration. (See also W90-01750) (Friedmann-PTT)
W90-01751

**UNDERSTANDING THE RESPONSE TO ENVIRONMENTAL RISK INFORMATION.**
Illinois Univ. at Urbana-Champaign. Inst. for Environmental Studies.
For primary bibliographic entry see Field 6B.
W90-01752

**ABIOTIC TRANSFORMATION OF HALOGENATED ORGANIC COMPOUNDS: II. CONSIDERATIONS DURING WATER TREATMENT.**
Florida International Univ., Miami. Drinking Water Research Center.
W. J. Cooper, R. A. Slifker, J. A. Jones, and O. A. El-Shazly.
IN: Biohazards of Drinking Water Treatment, Lewis Publishers, p 37-46, 1989. 2 fig, 3 tab, 28 ref. US EPA Grant R-811473-01-0.

Descriptors: *Water treatment, *Halogens, *Organic compounds, *Water distribution, Chlorination, Drinking water, Potable water, Chemical reactions, Hydrogen ion concentration.

Several compounds were examined under conditions likely to be encountered during water treatment and distribution. Compounds studied in detail were 1,1,1,2-tetrachloroehane, 1,1,2,2-tetrachloroehtnae, and pentachloroethane. The waters studied were either tap water from tow locations Miami or water from two treatment plants, sampled after lime softening and prior to recarbonation. It was found that normal practice of lime softening and water distribution at pH 9 will promote significant abiotic transformation of chlorinated ethanes. Elimination is the only important reaction pathway for the three compounds studied, at room temperature and neutral or basic pH. The elimination reactions in all cases are first order in halogenated ethane and first order in hydroxide ion. The disappearance of 1,1,1-trichloroehane is independent of pH over the limited range of pH examined. Heavy metals i solution do not affect the rate of the elimination reaction of 1,1,2,2-tetrachloroethane at neutral pH. (See also W90-01750) (Friedmann-PTT)
W90-01753

**TRANSFORMATION OF KINETICS OF 1,1,1-TRICHLOROETHANE TO THE STABLE PRODUCT OF 1,1-DICHLOROETHANE.**
Florida Univ., Gainesville.
P. V. Cline, and J. J. Delfino.
IN: Biohazards of Drinking Water Treatment, Lewis Publishers, p 47-56, 1989. 3 fig, 3 tab, 14 ref.

Descriptors: *Water chemistry, *Organic compounds, *Chemical properties, *Kinetics, *Volatility, *Chemical degradation, *Water treatment, Drinking water, Potable water, Water quality control.

1,1-Dichloroethane (1,1-DCE) was one of the five most frequently detected volatile organic compounds, other than trihalomethanes, in finished drinking water supplies according to the U.S. E.P.A. One source of this compound occurs during the abiotic degradation of 1,1,1-trichloroethane (TCA). The overall rate of degradation of TCA and the proportion of products formed, as well as the definition of parameters that influence these factors, were determined. It was found that the abiotic degradation of TCA in water occurs relatively rapidly compared to trends observed for many other alkyl halides. The pattern is consistent with that predicted for a true SN1 or E1 mechanism, with the role of the solvent more related to its overall ionizing power than to its potential role as a nucleophile. The mechanisms involves the formation of an ionic intermediate. The primary evidence for the formation of an intermediate that does not involve direct attack by a nucleophile is the lack of increase in the rate constant with the concentration of hydroxide as high as 2.0 M. Therefore, high pH or concentrations of nucleophiles would not be expected to accelerate the degradation rate. The transformation of TCA to 1,1-DCE and the stability of the ethene under typical environmental conditions contribute to the frequency at which this elimination product is observed in water supplies. (See also W90-01750) (Friedmann-PTT)
W90-01754

**ELIMINATION OF VIRUSES AND BACTERIA DURING DRINKING WATER TREATMENT: REVIEW OF 10 YEARS OF DATA FROM THE MONTREAL METROPOLITAN AREA.**
Institut Armand-Frappier, Laval (Quebec). Centre de Recherche en Virologie.
P. Payment.
IN: Biohazards of Drinking Water Treatment, Lewis Publishers, p 59-65, 1989. 2 fig, 6 tab, 1 ref.

Descriptors: *Drinking water, *Water treatment, *Viruses, *Enteric bacteria, *Disinfection, *Human pathogens, *Chlorination, *Ozonation, Raw water, Potable water, Water quality control, Water quality, Coliforms, Bacteria.

Results and experience accumulated in the laboratory since 1975 for the detection and elimination of viruses and bacteria from drinking water are reviewed. Virus isolation and elimination was achieved via chlorination, sedimentation, filtration, and ozonation. Raw and finished water samples were compared. Overall, viruses were detected after treatments that theoretically should have removed more than 12 log of viruses. Bacteria from the total coliform group, as well as some Pseudomonas aeruginosa, were occasionally detected in finished water, but they were mostly below the limit of detection of the standard 100 ml test. These low levels of bacterial contaminants are not likely to be of public health significance. The data obtained at several water treatment plants have shown that, except under optimal conditions achieved in the laboratory, most filtration plants will not remove all human enteric viruses. Such low-level viral contamination observed may not be a health problem, as increased incidence of disease due to drinking water is small and will require the surveillance of large populations to demonstrate any effect. (See also W90-01750) (Friedmann-PTT)
W90-01755

**FACTORS AFFECTING THE OCCURRENCE OF THE LEGIONNAIRES' DISEASE BACTERIUM IN PUBLIC DRINKING WATER SUPPLIES.**
Pittsburgh City Water Dept. PA.
S. J. States, J. M. Kuchta, L. F. Conley, R. S. Wolford, and R. M. Wadowsky.
IN: Biohazards of Drinking Water Treatment, Lewis Publishers, p 67-83, 1989. 7 fig, 2 tab, 37 ref. U.S. E.P.A. Cooperative Agreement CR80681-01-2.

Descriptors: *Path of pollutants, *Water supply, *Potable water, *Drinking water, *Legionella, Coliforms, Water pollution, Human pathogens, Bacteria, Pollutant identification.

The survival, multiplication, and inactivation of Legionella in municipal water supplies, internal plumbing systems, and bacterial amplifiers were investigated. It was found that Legionella appears to be less susceptible to chlorine than are the indicator coliform bacteria. Chlorine resistance is further enhanced by higher pH levels, lower temperatures, and previous exposure to chlorine. Metal plumbing components and associated corrosion products are important factors in the survival and growth of L. pneumophila in plumbing systems. Although Legionella is not readily isolated from municipal water supplies, the systems are capable of supporting its growth. Prevention of legionellae growth is aided by maintenance of chlorine residuals, effective filtration, and reduction of growth-supporting algae, protozoa, and leaf litter by covering sedimentation basins and reservoirs. Operating cooling towers outside of the optimal environmental tolerance range for Legionella multiplication (i.e., at pH $> 9$) may be useful in controlling its growth habitat. (See also W90-01750) (Friedmann-PTT)
W90-01756

**PRESENCE OF FUNGI IN DRINKING WATER.**
West Chester Univ. of Pennsylvania. Dept. of Biology.
W. D. Rosenzweig, and W. O. Pipes.
IN: Biohazards of Drinking Water Treatment, Lewis Publishers, p 85-93, 1989. 3 tab, 35 ref.

Descriptors: *Drinking water, *Potable water, *Fungi, *Aquatic fungi, *Pathogenic fungi, Pollutant identification, Human pathogens, Pollutants, Water quality, Public health.

Earlier reports of fungi in drinking water systems are reviewed, along with some recent results from recent field surveys. The most common isolates in service mains have been Cephalosporium, Verticillium, Trichoderma, Nectria, Phoma, and Phialophora. In groundwater, some of isolates have included Acremonium, Penicillium, and Sporacybe. Members of the genera Penicillium and Nomurae have been among the isolates found on pipe surfaces, three-quarters of which were found have filamentous fungi. It is apparent that some fungi survive water treatment processes in small numbers, although the majority are eliminated. The exact role of fungi in human health and interference with the operation of the water distribution system requires additional studies. (See also W90-01750) (Friedmann-PTT)
W90-01757

**PATHWAYS FOR THE PRODUCTION OF ORGANOCHLORINE COMPOUNDS IN THE CHLORINATION OF HUMIC MATERIALS.**
Technische Hogeschool Delft (Netherlands). Lab. for Analytical Chemistry.
E. W. B. de Leer, and C. Erkelens.
IN: Biohazards of Drinking Water Treatment, Lewis Publishers, p 97-106, 1989. 5 fig, 3 tab, 20 ref.

Descriptors: *Chlorinated hydrocarbons, *Organic compounds, *Drinking water, *Water treatment, *Chlorination, *Humic acids, Disinfection, Water quality control, Chemical reactions, Chemical properties.

The production of organochlorine compounds in the chlorination of drinking water is well known. The different pathways for the production of organochlorine compounds was investigated using KMnO4 preoxidation of humic acid to destroy resorcinol precursor structures. It was shown that the reaction of chlorine with resorcinol structures in humic materials may explain the production of chloroform. Resorcinol derivatives gave a chloroform production yield of 72-97% when the ring position between the two hydroxyl groups was unsubstituted. However, substitution of this 2-position with a hydroxyl or a methyl group reduced the chloroform yield to 0-8%. Substitution of the 2-position with a carboxyl group gave no significant reduction in chloroform yield, indicating that the carboxyl group can be expelled through oxidation and substitution reactions. Oxidation of terrestrial humic acids was performed at pH 7.2 and 10.4 with increasing amounts of KMnO4 to ensure complete oxidation of resorcinol structures. KMnO4 was completely consumed up to 2 mg

KMnO4/mg C. It is concluded that resorcinol structures in humic materials my explain part of the organochlorine production, although some important chlorination products such as dichloropropanedioic acid cannot be explained on the basis of resorcinol precursor structures. Thus, several amino acids were also explored as precursors for organochlorine compounds. Aspartic acid, glutamic acid, and uracil were among the amino acids that gave small amounts of dichloropropanedioic acid or 2,2-dichlorobutanedoic acid. When the reactivity of proteins and amino acids under normal chlorination conditions in drinking water treatment can be demonstrated, they may explain several of the chlorination products that cannot be understood on the basis of resorcinol structures. (See also W90-01750) (Friedmann-PTT)
W90-01758

**GC/MS IDENTIFICATION OF MUTAGENS IN AQUEOUS CHLORINATED HUMIC ACID AND DRINKING WATERS FOLLOWING HPLC FRACTIONATION OF STRONG ACID EXTRACTS.**
Environmental Protection Agency, Cincinnati, OH.
W. E. Coleman, J. W. Munch, P. A. Hodakievic, F. C. Kopfler, and J. R. Meier.
IN: Biohazards of Drinking Water Treatment, Lewis Publishers, p 107-121, 1989. 6 fig, 3 tab, 18 ref.

Descriptors: *Pollutant identification, *Drinking water, *Gas chromatography, *Mass spectrometry, *Chlorination, *Humic acids, Water treatment, Disinfection, Water quality control, Mutagenicity.

Method of identification of chlorination by-products are reviewed and the similarity of mutagenic disinfection by-products in chlorinated humic acid (CHA) and drinking waters is presented. Isolation, fractionation, and derivatization techniques in conjunction with high resolution capillary column GC/MS analysis have proven to be valuable tools in characterizing mutagenic activity in CHA solutions and in drinking waters. The characterization of mutagenic activity in test samples seems to be limited by problems in the analytical methodologies. I spite of improvements in isolation, concentration, and fractionation techniques, it will become necessary in future work to use more advanced mass spectroscopy (MS) techniques such as LC/MS and MS/MS with soft ionization in order to analyze these highly polar and labile constituents directly and quantitatively, thus avoiding derivatization and high temperature GC. The identification of disinfection by-products that are important contributors to the mutagenic activity of drinking water should provide a way of ranking chemicals for further testing in the more expensive animal carcinogenesis bioassays that are currently used to develop regulatory standards for carcinogens. The results of this study indicated that source waters containing significant humic materials produce, when chlorinated under drinking water treatment conditions, many of the same types of mutagenic compounds that are found in CHA solutions. These data indicate that additional health effects and treatment studies are necessary in order to determine the quantitative and qualitative impact of both MX-type compounds and chlorinated strong acids on human health. (See also W90-01750) (Friedmann-PTT)
W90-01759

**AMINO ACIDS AS MODEL COMPOUNDS FOR HALOGENATED BY-PRODUCTS FORMED ON CHLORINATION OF NATURAL WATERS.**
Monsanto Co., St. Louis, MO.
M. L. Trehy, R. A. Yost, and C. J. Miles.
IN: Biohazards of Drinking Water Treatment, Lewis Publishers, p 133-140, 1989. 3 fig, 33 ref.

Descriptors: *Chlorination, *Natural waters, *Water treatment, *Amino acids, *Organic compounds, *Chemical properties, Water quality control, Disinfection.

Studies of the formation of dihaloacetonitriles (DHAN) as a by-product of the exposure of amino acids aspartic acid, tyrosine and tryptophan to chlorination are reviewed. Although the presence of DHAN in the chlorination of water for disinfection may be attributable to precursors other than amino acids, the potential for amino acids to be present in lake water and in wastewater is well-documented. Amino acids, either in a combined form or possibly as free amino acids, are common constituents of the environment. Coastal plain rivers of the southeastern U.S. contain approximately 2 ppm of total amino acids with aspartic acid at approximately 0.3 ppm. In addition to amino acids, peptides present either in the environment or in vivo can also react with aqueous chlorine to form N-chloramines. The chlorination by-products of amino acids are of concern, because amino acids are likely to be present in the environment and a portion of the by-products formed on chlorination may be mutagenic. (See also W90-01750) (Friedmann-PTT)
W90-01761

**TOXICOLOGICAL SIGNIFICANCE OF THE CHEMICAL REACTIONS OF AQUEOUS CHLORINE AND CHLORAMINES.**
Old Dominion Univ., Norfolk, VA. Dept. of Chemical Sciences.
F. E. Scully, K. Mazina, D. E. Soneshine, and H. P. Ringhand.
IN: Biohazards of Drinking Water Treatment, Lewis Publishers, p 141-150, 1989. 28 ref. U.S. E.P.A. Grant CR-813092.

Descriptors: *Toxicity, *Biochemistry, *Chlorination, *Water treatment, *Disinfection, Oxidation, Biological properties, Biochemistry, Halogens, Chemical properties.

Since aqueous chlorine and, to an ever-increasing extent, inorganic monochloramines are widely used as disinfectants, it is important to determine what reactions these oxidants can undergo in the body and whether their products exhibit adverse health effects or can be detoxified. A number of reactions of aqueous chlorine and chloramine with organic components of biological fluids, including gastric juice, in vivo and in vitro, are reviewed. Aqueous chlorine is an oxidizing agent as well as a chlorinating agent. Operationally, it has been convenient to identify the halogenated products of the reactions of chlorine disinfectants with organics, because the presence of a chlorine atom is a specific indicator that a chlorination reaction has taken place. However, oxidation products that do not contain halogen atoms are also possible and may exhibit toxicological effects; these, however, will be far more difficult to identify. (See also W90-01750) (Friedmann-PTT)
W90-01762

**OZONE OXIDATION PRODUCTS: IMPLICATIONS FOR DRINKING WATER TREATMENT.**
Rice International Consulting Enterprises, Ashton, MD.
R. G. Rice.
IN: Biohazards of Drinking Water Treatment, Lewis Publishers, p 153-170, 1989. 1 fig, 1 tab, 41 ref.

Descriptors: *Drinking water, *Potable water, *Water treatment, *Water chemistry, *Ozonation, *Ozone, Chlorination, Chlorine, Water quality control, Filtration, Flocculation, Oxidation.

Implications for water treatment with ozone is reviewed through a retrospective examination of the literature. Combining prefiltration ozone oxidation with primary disinfection in the same treatment step will eliminate the need for postfiltration primary disinfection with ozone, chlorine, or chlorine dioxide. Consequently, only a secondary disinfectant will be required. In the case of chlorine, this will result in lower concentrations of THMs and other halogenated organics. Low-level ozonation (0.5-1.5 mg/L applied ozone dosages) apparently can produce low levels of mutagenicity. Higher ozone dosages produce waters containing no mutagenicity. Although the aldehydes formed upon ozonation are not readily removed from solution by flocculation/filtration, they are readily decomposed biologically to CO2 and water in sand filters (provided no residual disinfection is present) or GAC filter/adsorbers. If bromide ion is present in water being ozonated, brominated organic materials can be produced, as a result of oxidation of bromide ion to hypobromite ion. Chlorine and chlorine dioxide also are known to oxidize bromide ion similarly. Once produced, halogenated organics are difficult to remove. Ozonation of the insecticides parathion and malathion produces paraoxon and malaoxon, respectively, which are at least as toxic as the initial thions. Continued ozonation, however, oxidizes these intermediates further, producing innocuous ultimate oxidation products. (See also W90-01750) (Friedmann-PTT)
W90-01763

**FORMATION OF AROMATIC POLYMERS DURING THE OZONATION OF ENZYMATIC OXIDATION OF WATERS CONTAINING PHENOLIC COMPOUNDS.**
Centre de Recherche Lyonnaise des Eaux - Degremont, Le Pecq (France).
J. Duguet, A. Bruchet, B. Dussert, and J. Mallevialle.
IN: Biohazards of Drinking Water Treatment, Lewis Publishers, p 171-184, 1989. 10 fig, 2 tab, 12 ref.

Descriptors: *Aromatic compounds, *Organic compounds, *Water treatment, *Phenols, *Ozonation, *Polymers, Chemical properties, Ozone, Enzymes, Drinking water, Chlorination, Water quality control.

Natural or synthetic organic compounds are usually present in raw waters at low concentrations (ng/L to micrograms/L). Even at low concentrations, these compounds may cause taste and odor problems or present a health risk. Many studies concerning the ozonation of these compounds have focused on means of opening the aromatic rings, but little work has focused on polymerization of ozone. The polymerization effects obtained by ozonation or compared with those of enzymatic reaction (HRP-H2O2) on a chlorinated phenol, the 2,4-dichlorophenol. It was found that whatever the initial concentrations of 2,-4-dichlorophenol (2,4-DCP), the elimination is better than 95% for low-ozone doses or enzymatic activities corresponding to small quantities of enzyme (10 units/mg of DCP). Under these conditions, 2,4-DCP is removed following an oxidative coupling pathway as shown by different analysis techniques. This polymerization is characterized by the formation of quantities of insoluble compounds (25% to 45% for 100 mg/L initial concentration of 2,4-DCP) easily removed by classical treatments, and soluble compounds that have apparent molecular weights, for the most part, below 5000 daltons. (See also W90-01750) (Friedmann-PTT)
W90-01764

**BY-PRODUCTS FROM OZONATION AND PHOTOLYTIC OZONATION OF ORGANIC POLLUTANTS IN WATER: PRELIMINARY OBSERVATIONS.**
Illinois State Water Survey Div., Champaign.
G. R. Peyton, C. S. Gee, M. A. Smith, J. Brandy, and S. W. Maloney.
IN: Biohazards of Drinking Water Treatment, Lewis Publishers, p 185-200, 1989. 7 fig, 22 ref.

Descriptors: *Water chemistry, *Ozonation, *Water treatment, *Oxidation, *Organic compounds, *Organic wastes, Water quality control, Drinking water, Potable water.

A experimental procedure for the identification of oxidation by-products seen with ozonation and photolytic ozonation is described. The feedback relationship between the model development and product identification studies is described. It was found that carbonyl compounds formed as products of oxidation reactions can react with hydrogen peroxide, which is frequently present in such ozonation systems, to establish an equilibrium between parent compounds, significant amounts of hydroxyhydroperoxide, and more complex peroxidic products. The results indicate that peroxidic

products should be looked for in reaction mixtures from advanced oxidation processes. There may be health implications, especially where drinking water would be consumed immediately following treatment, as might be the case in a residential point-of-use treatment system. Also, it was found that phenylhydrazine derivatives of carbonyl compounds are oxygen-sensitive. Appropriate precautions should be taken in the analysis of such compounds. Preliminary data on two model compounds whose peroxy radicals do not easily eliminate superoxide indicate that the postulated tetroxide intermediate is useful in explaining the stable by-products that are formed in photolytic ozonation experiments. (See also W90-01750) (Friedmann-PTT)
W90-01765

**APPLICATION OF CLOSED LOOP STRIPPING AND XAD RESIN ADSORPTION FOR THE DETERMINATION OF OZONE BY-PRODUCTS FROM NATURAL WATER.**
California Univ., Los Angeles.
W. H. Glaze, M. Koga, E. C. Ruth, and D. Cancilla.
IN: Biohazards of Drinking Water Treatment, Lewis Publishers, p 201-210, 1989. 6 fig, 2 tab, 9 ref.

Descriptors: *Pollutant identification, *Ozone, *Resins, *Organic compounds, *Adsorption, *Water analysis, Sampling, Water supply, Ozonation, Water quality control, Gas chromatography, Mass spectrometry.

Ozone-produced by-products found in water samples taken from the Los Angeles Aqueduct Filtration Plant were evaluated. The use of Closed Loop Stripping Analysis (CLSA) and XAD-4/8 resin adsorption methods for the isolation of by-products present in water is demonstrated. Water samples were analyzed by the CLSA method. In the raw aqueduct water, straight-chain aldehydes (C9-C11) were commonly observed with nonanal and decanal being the most abundant. Also, 2-ethylhexanol and geranylacetone were present. After ozonation, the concentration of strippable aldehydes increased, the major by-product being heptanal. Analysis of the finished water showed a lower concentration of strippable compounds compared to the ozonated sample. With the XAD-4/8, each component was identified through comaprison of library spectra or, when available, through mass spectra and gas chromatography retention data of authentic standards. The concentration of most fatty acids was found increase after ozonation, while concentration of the naturally occurring fatty acids, C14, C16, C18, and C20 decreased. Fatty acid extraction efficiency was about 20%, about 7% for phenol-d5, and 85% for naphthalene-d8. (See also W90-01750) (Friedmann-PTT)
W90-01766

**ROLE OF GRANULAR ACTIVATED CARBON IN THE REDUCTION OF BIOHAZARDS IN DRINKING WATER.**
Cincinnati Univ. Medical Center, OH. Dept. of Environmental Health.
M. W. Tabor.
IN: Biohazards of Drinking Water Treatment, Lewis Publishers, p 213-233, 1989. 9 fig, 2 tab, 50 ref. USPS-NIEHS Grant ES00159, U.S. EPA Grant CR808603, NSF Grant PCM-82 19912.

Descriptors: *Drinking water, *Potable water, *Water treatment, *Activated carbon, *Organic compounds, Gas chromatography, Mass spectrometry, Mutagenicity, Carbon, Water quality control, Chemical properties.

Residue organics isolated from granular-activated carbon (GAC) used extensively for water treatment, was examined using high-performance gas chromatography and mass spectrometry. Results showed that treatment of water with GAC efficiently and preferentially removed mutagens relative to other chemicals, that made up the water total organic carbon, and this removal was shown to continue long after the percent of total organic carbon reduction reached a steady state. The most significant residue isolated from the GAC were two distinct fractions of TA100 direct-acting mutagens, one of which was labile in terms of loss of bioactivity whereas the other was stable. This led to the application of a previously reported method to the stabilization of the labile mutagens as NTP-adducts. The adducts were separated, and one was tentatively identified as a N-(2,6-diethylphenyl)-N-methoxymethylacetamide-NTP adduct. This adduct would indicate the presence of a derivative related to an herbicide known not to be mutagenic in Salmonella bioassays. GAC is shown to be a viable method for removing biohazardous organics from water. (See also W90-01750) (Friedmann-PTT)
W90-01767

**OXIDATION OF PHENOL ON GRANULAR ACTIVATED CARBON.**
Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
L. S. Chin, R. A. Larson, and V. L. Snoeyink.
IN: Biohazards of Drinking Water Treatment, Lewis Publishers, p 235-242, 1989. 7 fig, 11 ref.

Descriptors: *Drinking water, *Water treatment, *Oxidation, *Phenols, *Activated carbon, Water quality control, Adsorption, Organic compounds, Chemical properties, Carbon.

In drinking water treatment, granular activated carbon (GAC) is widely used to remove hydrophobic organic substances because of its high adsorptive capacity. It is shown GAC is able to promote the oxidation of phenol adsorbed from aqueous solution. 2,2'-dihydroxybiphenyl and 4-hydroxydiphenyl ether were the predominant products. The product yield was significantly dependent on the reaction pH and phenol adsorption. The presence of fulvic acid inhibited the formation of phenolic dimers and favored C-O dimer production. (See also W90-01750) (Friedmann-PTT)
W90-01768

**MICROBIOLOGY OF GRANULAR ACTIVATED CARBON USED IN THE TREATMENT OF DRINKING WATER.**
Montana State Univ., Bozeman. Dept. of Microbiology.
G. A. McFeters, A. K. Camper, D. G. Davies, S. C. Broadway, and M. W. LeChevallier.
IN: Biohazards of Drinking Water Treatment, Lewis Publishers, p 243-254, 1989. 2 fig, 2 tab, 36 ref. US EPA Grant CR 810015.

Descriptors: *Drinking water, *Potable water, *Water treatment, *Activated carbon, *Bacteria, *Human pathogens, Disinfection, Water quality control, Enteric bacteria, Microorganisms, Water quality, Coliforms.

Granular activated carbon (GAC) is widely used to control taste and order problems arising from a variety of sources in drinking water. THe same properties that make it an ideal medium for the adsorption of chemicals, however, also promote the colonization and growth of many types of bacteria. Findings of a four-year study, designed to determine whether enteric pathogenic bacteria can colonize and survive GAC, the susceptibility of the bacteria to disinfection, and incidence of GAC bacterial breakthrough in drinking water, are summarized. It was found that HPC and coliform bacteria colonize operational GAC filters, and populated particles are released even from properly maintained filters in drinking water. GAC-attached bacteria were not susceptible to chlorine levels commonly used to disinfect potable water. Enteric pathogens can colonize GAC and persist for a varied amount of time depending upon the indigenous HPC population present. Penetration of populated carbon fines through the treatment barriers was related to increased flow rate, bed depth of GAC filters, and decreased applied water quality. (See also W90-01750) (Friedmann-PTT)
W90-01769

**BIODEGRADATION PROCESSES TO MAKE DRINKING WATER BIOLOGICALLY STABLE.**
Illinois Univ. at Urbana-Champaign. Inst. for Environmental Studies.
B. E. Rittmann.
IN: Biohazards of Drinking Water Treatment, Lewis Publishers, p 257-263, 1989. 28 ref.

Descriptors: *Drinking water, *Potable water, *Water treatment, *Biodegradation, *Biochemistry, Chemical properties, Organic compounds, Degradation, Organic wastes, Aerobic treatment.

The biological processes used to make biologically stable drinking water stable are reviewed. When a water is biologically stable, it is free from organic and inorganic constituents that can biodegrade in the distribution system. This stability means that excessive chlorination need not be practiced, thereby abating the formation of THMs, TOX, tastes, odors, and odors that are associated with chlorination. The main inorganic source of biological instability is ammonia nitrogen, and it seldom is found at more than 3 mg N/L. However, concentrations as small as 0.25 mg N/L present significant problems of instability. Fortunately, biological treatment is capable of reducing NH4(+)-N concentration to 0.01 mg N/L or lower. The other major source of biological instability is biodegradable organic matter. Although the dissolved organic carbon (DOC) of most water supplies varies from 1 mg C/L to 10 mg C/L, the easily degradable portion usually is only a small fraction of the DOC. The most important aspects of biological treatment for preparation of a biologically stable water include biofilm type processes, use of a multiple-substrate system, and use of aerobic biological treatment processes. (See also W90-01750) (Friedmann-PTT)
W90-01770

**NEW HALAMINE WATER DISINFECTANTS.**
Auburn Univ., AL. Dept. of Chemistry.
S. D. Worley, D. E. Williams, S. B. Barnela, and L. J. Swango.
IN: Biohazards of Drinking Water Treatment, Lewis Publishers, p 271-287, 1989. 10 fig, 4 tab, 17 ref. US Air Force Contract DAMD 17-82-C-2257.

Descriptors: *Water treatment, *Disinfection, *Organic compounds, *Drinking water, *Water quality control, Water quality, Potable water.

There is a definite need for a new water disinfectant which exhibits long-term stability and does not react appreciably with organic impurities in water to form toxic trihalomethanes. Five N-halamine compounds were compared as stable disinfectants for water application. It was found that N-halooxazolidinones and N,N'-dihaloimidazolidinones represent useful new classes of disinfectants for water application. The great stability of these compounds renders them particularly useful for disinfection applications for which contact time is not of primary importance. Such applications include cooling towers, air conditioning systems, swimming pools, and hot tubs. The compound ABC (1-bromo-3-chloro-4,4,5,5-tetramethyl-2-imidazolidinone) is recommended as best for most applications because fo its rapid initial disinfection from the bromine moiety and slower, long-term disinfection from the chlorine moiety. (See also W90-01750) (Friedmann-PTT)
W90-01772

**REMOVAL OF NITRATE FROM GROUNDWATER BY A DIAPHRAGM PROCESS WITH SIMULTANEOUS REMOVAL OF THE CONCENTRATES PRODUCED WITH LITTLE RESIDUE (NITRATENTFERNUNG AUS GRUNDWAESSERN DURCH MEMBRANVERFAHREN BEI GLEICHZEITIGER, RUECKSTANDSARMER ENTSORGUNG DER ANFALLENDEN KONZENTRATE).**
Technische Hochschule Aachen (Germany, F.R.). Fakultaet fuer Maschinenwesen.
W. Kopp.
Available from National Technical Information Service, Springfield, VA 22161 as TIB/B88-81014/GAR, Price codes: E14 in paper copy. January 16, 1987. 199p, 140 fig, 42 tab, 99 ref, 1 append. No English summary.

Descriptors: *Water treatment, *Membrane processes, *Nitrates, *Nitrogen removal, Reverse osmosis, Groundwater pollution, Groundwater, Electrodialysis.

Groundwater is endangered by a rising nitrate content (waste water, precipitation, artificial fertilizers, liquid manure). If one cannot keep within the nitrate limits by dilution with water low in nitrates or by obtaining water from other sources, then cheap, safe processes for reducing and removing the nitrates must be introduced. The aim of this scientific work was therefore to examine whether diaphragm processes are suitable for reducing the nitrate content. Reverse osmosis for removing nitrates is considered first (basis, pretreatment of water, pilot plant, results of experiments, design of a large plant, judging small plants for treating water domestically). The structural, functional and capacity characteristics of the electrodialysis process and with the combination of reverse osmosis to achieve a higher water yield is then considered. Finally, the evaporation process for removal of concentrates produced with little residue and various treatment concepts are compared with one another. (Author's Abstract)
W90-01784

## 5G. Water Quality Control

**DESIGN OF A DIVERSION SYSTEM TO MANAGE THE FIRST FLUSH.**
Virginia Polytechnic Inst., Blacksburg. Dept. of Civil Engineering.
For primary bibliographic entry see Field 4A.
W90-00965

**CHANGES IN STRATIFICATION IN ONONDAGA LAKE, NEW YORK.**
Massachusetts Inst. of Tech., Cambridge. Ralph M. Parsons Lab.
For primary bibliographic entry see Field 2H.
W90-00974

**MANAGING GROUND WATER QUALITY IN RELATION TO AGRICULTURAL ACTIVITIES.**
Maryland Univ., College Park. Dept. of Agricultural Engineering.
W. L. Magette, A. Shirmohammadi, B. V. Lessley, and R. A. Weismiller.
Water Resources Bulletin WARBAQ, Vol. 25, No. 3, p 599-606, June 1989. 1 fig, 35 ref.

Descriptors: *Water pollution control, *Groundwater management, *Groundwater quality, *Agricultural runoff, *Environmental policy, Modeling, Geographic information systems.

Groundwater quality is an environmental issue of national concern. Agricultural activities, because they involve large land areas, often are cited as a major contributor of groundwater contaminants. It appears that some degree of groundwater contamination from agricultural land use is inevitable, especially where precipitation exceeds evapotranspiration. For this reason, and because agriculture differs significantly from point sources of pollution, farmers, policy makers, and scientists need alternative management strategies by which to protect groundwater. Mathematical models coupled to geographic information systems to form expert systems can be important management tools for both policy makers and agricultural producers. An expert system can provide farmers, researchers, and environmental managers with information by which to better manage agricultural production systems to minimize groundwater contamination. Significant research is necessary to perfect such a system, necessitating interim groundwater management strategies that include not only a strong research program, but educational and public policy components as well. (Author's abstract)
W90-00975

**WATER QUALITY AND MACROINVERTEBRATE POPULATIONS BEFORE AND AFTER A HAZARDOUS WASTE CLEANUP.**
Ball State Univ., Muncie, IN. Dept. of Natural Resources.
H. F. Siewert, C. J. Miller, and B. G. Torke.
Water Resources Bulletin WARBAQ, Vol. 25, No. 3, p 685-689, June 1989. 7 tab, 21 ref.

Descriptors: *Fate of pollutants, *Water quality, *Hazardous wastes, *Water pollution treatment, *Cleanup, *Species diversity, *Macroinvertebrates, Indiana, Dissolved solids, Cleanup operations.

Water samples and macroinvertebrates were collected from Finley Creek, Indiana, both before and two years after the cleanup of a nearby hazardous waste site. Water quality constituents were compared between years. Below the disposal site higher concentrations of constituents were found before and after the cleanup. However, two years after the cleanup, an improvement of water quality was observed. Total dissolved solids decreased by 52% and macroinvertebrate taxa increased by 44%. (Author's abstract)
W90-00984

**METHODS AND EXPERIENCES OF MONITORING AMMONIA, NITRATE, CARBON DIOXIDE, PHOSPHORUS AND CHLOROPHYLL-A IN WATER POLLUTION CONTROL OF RUNNING WATERS (MOGLICHKEITEN UND ERFAHRUNGEN MIT MEBSTATIONEN AN FLIEBGEWASSERN, INSBESONDERE DER KONTINUIERLICHEN ERFASSUNG VON AMMONIUM, NITRAT, KOHLENSTOFFDIOXID, 0-PHOSPHAT UND CHLOROPHYLL-A).**
Bayerische Landesanstalt fuer Wasserforschung, Munich (Germany, F.R.).
For primary bibliographic entry see Field 5A.
W90-00985

**STOCHASTIC PHOSPHOROUS MODEL FOR ONONDAGA LAKE.**
Michigan Univ., Ann Arbor. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2H.
W90-01000

**FEDERAL REGULATION OF AGRICULTURAL DRAINAGE ACTIVITY IN PRAIRIE POTHOLES: THE EFFECT OF SECTION 404 OF THE CLEAN WATER ACT AND THE SWAMPBUSTER PROVISIONS OF THE 1985 FARM BILL.**
S. L. Hofer.
South Dakota Law Review, Vol. 33, No. 3, p 511-527, 1988. 162 ref.

Descriptors: *Prairies, *Wetlands, *Potholes, *Drainage, *Agriculture, *Water pollution control, *Environmental policy, *Legal aspects, *Regulations, *Legislation, Clean Water Act, Food Security Act, Farm Bill, Swampbuster provisions.

Draining prairie potholes was once a relatively simple task, the only prerequisites being a neighbor's permission and the proper equipment. Changing public and private views toward the conservation of these prairie wetlands, however, have resulted in federal regulation and restriction of agricultural drainage activities. Section 404 of the Clean Water Act and the swampbuster provisions of the Food Security Act of 1985 were enacted to preserve wetlands from being converted to agricultural use. The swampbuster provisions discourage converting prairie potholes and other wetlands for agricultural production by essentially imposing economic sanctions on the farmers who expand their acreage under cultivation by converting wetlands for agricultural purposes. Both regulatory measures provide vehicles through which drainage can be accomplished if it is economically logical for a farmer to do so. Arguably, draining a singular prairie pothole will not impair the public benefits of the nation's wetlands. The cumulative effect of such numerous piecemeal changes in the wetlands over the previous hundred years permits a strong argument that draining prairie potholes should be allowed only in limited situations. (Sand-PTT)
W90-01008

**DRASTIC APPROACH TO CONTROLLING GROUNDWATER POLLUTION.**
L. Ng.
Yale Law Journal, Vol. 98, No. 4, p 773-791, 1989. 118 ref.

Descriptors: *Regulations, *Water pollution control, *Groundwater pollution, Legal aspects, Legislation, Statistical methods.

Groundwater contamination is an environmental issue of greatest importance, but current federal and state efforts to protect groundwater describe a patchwork of activities and programs that is not adequate to the task. The most crucial factors in determining groundwater pollution potential-those described by the acronym, DRASTIC-consist of depth to water, recharge, aquifer media, soil media, topography, impact of the vadose zone, and conductivity of the aquifer. The DRASTIC relative ranking scheme uses a combination of weights and ratings to produce a numerical value, called the DRASTIC Index, which allows for the ranking of areas according to groundwater contamination vulnerability. The system optimizes the use of existing data, thus minimizing the need for costly and time-consuming geologic and hydrologic surveys, and provides an evaluation which can be used to direct resources, waste disposal, and land use activities. The proposed modified effluent charge approach would establish a coordinated framework for national groundwater protection efforts to increase incentives for groundwater pollution prevention. While some discharges may never affect groundwater, the use of the proposed effluent charge system would create a continuing incentive for dischargers to develop low-cost abatement strategies. The proposed approach is a pragmatic one, founded on the pressing need to prevent the practically irreversible destruction of crucial groundwater resources. (Sand-PTT)
W90-01009

**COMPARING OPTIONS FOR IMPROVING DISSOLVED OXYGEN BELOW HYDROPOWER DAM.**
General Motors Research Labs., Warren, MI. Environmental Science Dept.
B. R. Kim, and C. E. Bohac.
Journal of Energy Engineering JLEED9, Vol. 115, No. 2, p 63-77, Aug 89. 6 fig, 4 tab, 25 ref.

Descriptors: *Water quality management, *Environmental effects, *Dam effects, *Hydroelectric plants, *Dams, *Dissolved oxygen, *Aeration, Turbines, River flow, Model studies, Simulation, Oxygen injection systems, Fort Patrick Henry Dam, Tennessee.

Many existing dams will have to address issues of minimum dissolved oxygen concentration and minimum flow before they can be relicensed. All new hydropower applications also must address such issues. Although technology has been developed to reaerate hydropower releases, trade-offs exist between oxygen levels in the release and the minimum flow provided in relation to downstream assimilative capacity. A case history of the Fort Patrick Henry Dam in Tennessee, beginning with the development of the aeration technology followed by the analysis of the impacts of increased dissolved oxygen concentration and river flow on assimilative capacity, is presented. Testing of both in-reservoir oxygen injection systems and turbine aeration systems is described. A modified Streeter-Phelps model was used to evaluate the effectiveness of aerating the releases and increasing the minimum flows from the dam. The effects of reducing municipal and industrial waste load on dissolved oxygen concentration were also compared to the effects of aerating the releases and changing minimum river flow. For this particular use, increasing minimum flows was found to be one of the most attractive alternatives for increasing the minimum dissolved oxygen concentration predicted in the river.(Author's abstract)
W90-01038

**IMPROVING SOUTHERN CALIFORNIA'S COASTAL WATERS.**

Southern California Coastal Water Research Project Authority, Long Beach.
H. Schafer.
Journal - Water Pollution Control Federation JWPFA5, Vol. 61, No. 8, p 1394-1401, August 1989. 6 fig, 27 ref.

Descriptors: *Sludge disposal, *Ocean dumping, *Wastewater outfall, *Water pollution prevention, *Legislation, *California, *Coastal waters, DDT, Polychlorinated biphenyls, Heavy metals, Cadmium, Chromium, Zinc, Copper, Municipal wastewater, Wastewater facilities, Beach contamination.

During the first half of this century, raw screened domestic and industrial wastes were discharged to coastal waters with little or no effective regulation. Harbor and near-shore discharges were tolerated for years as long as coastal discharge sites were remote from population centers and human activity. One of the population centers that took advantage of the available deep open ocean waters for wastewater disposal was the Southern California coastal region. This caused both bacterial and chemical contamination of ocean water and beaches. The waters off the coast of Southern California have had the highest chlorinated hydrocarbon levels of any open coastal areas for the last 40 years. Legislation passed in 1966 (the Porter-Cologne Act) gave the Water Quality Control Boards adequate power to control waste discharges. In 1972, California adopted the State Ocean Plan, the first of its kind in the nation, that provided guidance to the Regional Boards for regulation of industrial and municipal discharges to coastal waters. Improved wastewater treatment facilities, the termination of ocean disposal of sludges in 1987 and decreases in ocean emissions have all combined to result in improved ocean water quality. . Emissions of DDT, PCBs, and heavy metals have all decreased despite an increase in flow. Combined inputs of cadmium(30%), chromium (28%), copper (33%), and zinc (22%) are expected to decrease because ocean disposal of sludge through the Los Angeles County outfall was discontinued in November 1987. Because this sludge outfall was not a major source of chlorinated hydrocarbons, its elimination will only reduce the combined input of DDT by 2% and PCBs by 1%. (Peters-PTT)
W90-01046

**CONTROL STRATEGIES FOR COMBINED SEWER OVERFLOW.**
Piper and Marbury, Washington, DC.
For primary bibliographic entry see Field 5D.
W90-01047

**WASTE DISPOSAL AND GROUNDWATER MANAGEMENT.**
Binnie and Partners, Redhill (England).
For primary bibliographic entry see Field 5E.
W90-01078

**MANAGEMENT AND CONTROL OF URBAN RUNOFF QUALITY.**
Middlesex Polytechnic, Enfield (England). Urban Pollution Research Center.
J. B. Ellis.
Journal of the Institution of Water and Environmental Management, Vol. 3, No. 2, p 116-124, April 1989. 2 fig, 1 tab, 20 ref.

Descriptors: *Water quality management, *Water quality control, *Urban runoff, *Sewer systems, *Catchment areas, *Drainage programs, *Urban drainage, Outfall sewers, Rainfall-runoff relationships, Management planning, Economic efficiency, Legislation, Social aspects, Storm runoff, Storm-overflow sewers, Water pollution control.

The design, operation, and management of urban sewerage systems need to identify the best investment profiles for catchment drainage management which extends from the point of rainfall to the point of outfall in order to provide maximum benefit and protection for both customer and environment. There can be no doubt that strategic urban catchment management which would result in a cost-effective, planned private/public expenditure profile, is now technically feasible. The outstanding, but nevertheless real, difficulties which remain in achieving this objective are predominantly institutional and organizational issues although there are many legislative and social issues that will require addressing. It is recommended that effective source control procedures for stormwater runoff control must form the basis for best practical options for achieving integrated pollution control in urban catchments. (Fish-PTT)
W90-01079

**IMPACT OF FLUE-GAS DESULPHURIZATION ON THE WATER ENVIRONMENT.**
Environmental Sciences Ltd., Vancouver (British Columbia).
For primary bibliographic entry see Field 5C.
W90-01088

**CONTROL OF POLLUTION ACT 1974, PART II REGISTERS--PROMOTING THE PUBLIC INTEREST (ABRIDGED).**
Hull Univ. (England). School of Law.
T. P. Burton.
Journal of the Institution of Water and Environmental Management, Vol. 3, No. 3, p 260-261, June 1989. 1 ref.

Descriptors: *Water quality management, *Water pollution control, *Information systems, *Industrial wastewater, *Public participation, Wastewater treatment, Legislation, Public rights, Legal aspects, England.

Under the U.K.'s Control of Pollution Act 1974, Part II the water authorities (WAs) are required to maintain registers of information relating to industrial and sewage effluent discharge consents. As of 1 August 1985, the registers were required to be available for public inspection at all reasonable hours at the principal offices of each water authority. This legislation introduces a significant change, because it provides access to information which previously was not publicly available as of right. Furthermore, such information can be, and has been, used as the basis for private prosecutions against dischargers who breach their consents. If WA accountability is to be meaningful in practice, members of the public must be able to make use of the facilities which are designed for this purpose. It is believed that to date the WAs have not been sufficiently comprehensive and dynamic in their approach, either in terms of promoting awareness of the registers, or in making the registers, and the data contained therein, as accessible as possible. It is hoped that, possibly by forming a partnership with amenity groups, the interest of the public to utilize the registers can be promoted, and hence the public can achieve a meaningful and significant role in the consent monitoring process. (Fish-PTT)
W90-01093

**GROUNDWATER QUALITY MONITORING IN RELATION TO ON-SITE SANITATION IN DEVELOPING COUNTRIES.**
Southampton Univ. (England). Inst. of Irrigation Studies.
C. F. Ward.
Journal of the Institution of Water and Environmental Management, Vol. 3, No. 3, p 295-302, June 1989. 2 fig, 2 tab, 7 ref.

Descriptors: *On-site waste disposal, *Groundwater quality, *Water quality management, *Monitoring, *Developing countries, *Waste disposal, Sanitary engineering, Water resources development, Sampling, Investment, Groundwater pollution.

Groundwater quality monitoring is considered to be an essential component of any sanitation program where simultaneous groundwater abstraction and on-site waste disposal are proposed. The low priority currently accorded to monitoring programs reflects inexperience of monitoring in general and consequent misconceptions about the content and benefits of groundwater quality monitoring. Groundwater quality monitoring is a requisite component of all pilot sanitation projects which involve on-site disposal of human excreta, and it is not unrealistic to expect groundwater quality monitoring to be carried out in relation to all such pilot projects. The resource constraints inherent in developing countries need not prohibit routine monitoring. However, it is important to define clearly the specific objectives of any monitoring program and to design a sampling network appropriate to both these objectives and the site conditions. Monitoring must not be confused with initial assessment of prevailing conditions, nor with research studies, for which the aims, duration, technical complexity, and hence investment, are quite different. Monitoring is a process which can evolve with increased investment to address various questions regarding the causes, nature and processes of groundwater contamination. (Author's abstract)
W90-01098

**THINKING ABOUT NONPOINT SOURCES OF WATER POLLUTION AND SOUTH DAKOTA AGRICULTURE.**
J. H. Davidson.
South Dakota Law Review, Vol. 34, No. 1, p 20-62, 1989. 260 ref.

Descriptors: *Nonpoint pollution sources, *South Dakota, *Agriculture, *Regulations, *Water law, Clean Water Act, Water quality standards, Water permits, Water treatment, Effluent limitations, Permits, Pollution load.

The Clean Water Act of 1982 adopted a goal of no pollution discharges and mandated a system of technology-based, state-of-the-art, effluent limitations to supplement existing state water quality standards. The federal role in establishing water pollution policy was made pre-eminent, and the states were given the role of enforcement agents. This article reviews the Clean Water Act's positions on nonpoint water pollution concerning navigable waters, effluent limitations, water quality standards, permit system toxic pollutants, publicly owned treatment works, and dredge or fill permits. The paper distinguishes between point and nonpoint pollution sources and discusses the Federal Nonpoint Source Control Program before 1987. In 1987 amendments to the Federal Nonpoint Source Management Program were added. These require states to submit assessment reports identifying all water in the state which cannot reasonably be expected to attain or maintain applicable water quality standards. States must also submit to the EPA a management program describing implementation on nonpoint controls. States are eligible to receive federal grants for implementation of approved management plans. Grant programs for implementing management programs, interstate management conferences, upgrading of section 208 planning and other provisions are discussed. South Dakota's Soil Erosion and Sediment Drainage Control Law is presented. South Dakota's Department of Water and Natural Resouces' prescription for dealing with nonpoint source pollution tend to follow the norm of voluntary compliance. Full reliance is placed on the Soil Erosion and Sediment Damage Control Law. Farmers who have highly erodible land are adopting soil conservation plans in order to comply with the conservation compliance provisions of the Food Security Act of 1985. As information concerning agriculture as a source of water pollution becomes more broadly available, it is likely that there will be more calls for responsible land management. (Mertz-PTT)
W90-01105

**TOWARDS A NEW EC-WATERPOLICY.**
L. Ginjaar.
Environmental Policy and Law, Vol. 18, No. 6, p 210-219, December 1989. 7 ref.

Descriptors: *Public policy, *European community, *Water quality control, *Environmental protection, *Water law, Single Act, Groundwater management, Soil conservation, Regulations.

A policy has been devised within the European Communities to protect the quality of the aquatic environment. The Single Act of July 1987 is concerned with the quality of the environment and aquatic systems. Experiences to date with the European Communities' water policy can provide

ideas which result in an improvement in policy on water quality and the prevention of water pollution. However, a new policy must be developed to respond adequately to newly identified environmental problems. Pollution from black listed substances must be terminated, standards for sediments must be drawn up, and a new approach to groundwater and soil policy in the European Communities is needed. Procedures for dealing with the entire European Community as a whole or with individual states must be established. Suggestions for establishing these procedures are presented. (Mertz-PTT)
W90-01106

**CONTROL OF POLLUTION OF INLAND WATERS--A NECESSARY IMPULSE FOR THE BRITISH APPROACH.**
F. L. Blechschmidt.
Environmental Policy and Law, Vol. 19, No. 1, p 17-23, February 1989. 36 ref.

Descriptors: *Water pollution control, *Environmental protection, *Environmental policy, *England, *West Germany, Public policy, Water law, Water quality.

The United Kingdom joined the European Economic Community in 1973. Since then the community has been very active in every important field of environmental protection and has issued a comprehensive body of legislation comprising over 100 Directives, Regulations and Decisions. The German approach to maintain the quality of inland waters differs from the British one. The German approach is a sensible and adequate one to meet difficulties in maintaining the river quality as is no other approach within Europe. Britain, which is insisting on the theoretical correctness of the river quality approach, will have to accept that their quality objective approach is not the non-plus-ultra compared to a system of limit values such as the used in the Federal Republic. The British practice of quality objectives has been pragmatic, and perhaps the next stage would be for the British legislature to realize the practical advantage of the German approach: limit values and quality objectives must not be alternatives, they could be additional to each other. (Mertz-PTT)
W90-01107

**BIODEGRADATION OF TRICHLOROETHYLENE BY BACTERIA INDIGENOUS TO A CONTAMINATED SITE.**
Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.
K. L. McClellen, N. Buras, and R. C. Bales.
Journal of Environmental Science and Health (A) JESEDU, Vol. 24, No. 6, p 561-570, August 1989. 4 fig, 13 ref.

Descriptors: *Fate of pollutants, *Water pollution treatment, *Biodegradation, *Groundwater pollution, *Trichloroethylene, Microorganisms.

Bacteria indigenous to a trichloroethylene contaminated site were exposed to 0.56 and 6.7 mg/L trichloroethylene. Under the aerobic, oligotrophic conditions of the microcosms, the populations were able to degrade trichloroethylene and to increase their numbers by two orders of magnitude within one week. No other substrate was added. The average trichloroethylene disappearances were 47% and 33% for initial trichloroethylene concentrations of 0.56 and 6.7 mg/L, respectively. No trichloroethylene disappearance was observed in controls. Results of individual microcosms suggest that bacteria degraded trichloroethylene to levels as low as 1-2% of the initial concentration. Lag times of 14 and 18 days were observed for the 0.56 and 6.7 mg/l concentration microcosms, respectively. Bacterial population shifts were noted throughout the experiment. None of the isomers of a dehalogenation reaction were found. (Author's abstract)
W90-01123

**ENVIRONMENTAL LAW--WILL JURISDICTION ATTACH IN CITIZEN SUITS AGAINST WHOLLY PAST PERMIT VIOLATORS UNDER SECTION 505 OF THE CLEAN WATER ACT, 33 U.S.C. SECTION 1365. GWALTNEY OF SMITHFIELD V. CHESAPEAKE BAY FOUNDATION, INC., 108 S. CT. 376 (1987).**
For primary bibliographic entry see Field 6E.
W90-01127

**SANDOZ SPILL: THE FAILURE OF INTERNATIONAL LAW TO PROTECT THE RHINE FROM POLLUTION.**
California Univ., Berkeley. School of Law.
A. Schwabach.
Ecology Law Quarterly ECLQAR, Vol. 16, No. 2, p 443-480, 1989. 292 ref.

Descriptors: *Water pollution, *Rhine River, *International law, *Legal aspects, Law enforcement, Condemnation, Water law, Water pollution control.

The fire at Sandoz Warehouse 956 near Basel, Switzerland, in November 1986 and the subsequent spill of toxic chemicals into the Rhine river had a disastrous impact on the Rhine's ecology. The accident is widely regarded as Western Europe's worst environmental disaster in decades. Two treaties govern pollution resulting from incidents such as the Sandoz accident: the Convention Concerning the International Commission for the Protection of the Rhine Against Pollution and the Convention for the Protection of the Rhine Against Chemical Pollution. As the names of the treaties show, their purpose is to protect the Rhine from pollution. The Sandoz spill, and similar accidents of lesser magnitude, demonstrate that the Rhine has not been protected. Despite a treaty provision for arbitration and possible treaty violations by Switzerland, none of the downstream states sought any remedy against Switzerland under international law for damages caused by the Sandoz spill. This Comment discusses the Sandoz accident and its aftermath, explores the reasons for the failure of the Rhine treaty regime, and proposes remedies for the inadequacies of the existing treaties. (Author's abstract)
W90-01149

**GWALTNEY OF SMITHFIELD, LTD. V. CHESAPEAKE BAY FOUNDATION: ITS IMPLICATIONS FOR CITIZEN SUITS UNDER THE CLEAN WATER ACT.**
California Univ., Berkeley. School of Law.
For primary bibliographic entry see Field 6E.
W90-01150

**EPA'S PRETREATMENT PROGRAM.**
T. A. Gold.
Boston College Environmental Affairs Law Review BCERDX, Vol. 16, No. 3, p 459-530, 1989.

Descriptors: *Water law, *Water pollution control, *Wastewater treatment, *Administrative regulations, *Wastewater facilities, *Industrial wastes, Wastewater pollution, Surface water, Pollutants, Wastewater, Effluents.

Substantial quantities of toxic pollutants have been and still are being discharged into surface waters throughout the country. EPA primarily directed its efforts at controlling these toxic discharges at the direct discharge of toxics by industrial facilities. Large quantities of industrial wastewater, however, are not discharged directly into surface waters but are discharged indirectly to surface waters via public owned treatment works (POTWs). Therefore, the EPA is now placing greater emphasis on controlling the indirect discharge of toxic pollutants. The basic premise underlying this effort is that significant headway against toxic pollution of surface waters will not be made until American industry starts treating its toxic pollutants before discharging them into POTWs. As a result, the EPA's pretreatment program requires that Industrial Users treat their wastewater before it reaches a POTW, whether through compliance with national standards or with standards set by a POTW. The EPA's pretreatment standards consist of three basic elements. National categorical standards are specific effluent limitations for particular industrial categories. Prohibited discharge standards regulate nondomestic uses. Local limits are specific requirements developed by individual POTWs to implement the general and specific prohibitions and to attain compliance with other federal, state, and local requirements. (Gadsby-PTT)
W90-01171

**GROUNDWATER QUALITY REGULATION: EXISTING GOVERNMENTAL AUTHORITY AND RECOMMENDED ROLES.**
Wisconsin Univ.-Madison. Dept. of Agricultural Economics.
D. A. Yanggen, and L. L. Amrhein.
Columbia Journal of Environmental Law CJELE8, Vol. 14, No. 1, p 1-109, 1989.

Descriptors: *Water law, *Water pollution control, *Regulations, *Groundwater pollution, *Wastewater, Surface water, *Water quality, Pollutants, Degradation.

The quality of groundwater is threatened by degradation in many parts of the nation. While efforts have been made nationwide to improve the quality of surface water, these efforts have sometimes been at the expense of groundwater quality; some of the wastes that were previously disposed into surface waters or burned have now been diverted onto land or to subsurface disposal, ultimately degrading groundwater quality in many instances. The US Congress, many state legislatures, the US Supreme Court, and numerous federal and state courts have begun to recognize the value and necessity of groundwater protection. Many observers agree that the emphasis of regulations should be on the prevention of groundwater contamination rather than on the monitoring and clean-up of pollutants once contamination has occurred. There is disagreement, however, both as to the best approach to prevent contamination and as to which levels of government are best suited to carry out these tasks. Since there are a number of important variables affecting which approach is best designed to protect groundwater within a given jurisdiction, it may be argued that there is no single regulatory approach that all government should use; regulation should ideally reflect the hydrogeologic and land use characteristics of a given jurisdiction and should involve a cooperative effort between federal, state, and local government. (Gadsby-PTT)
W90-01173

**EPA'S PESTICIDES IN GROUNDWATER STRATEGY: WILL IT WORK.**
Beveridge and Diamond, Washington, DC.
C. A. Lewis, and J. D. Berry.
Natural Resources and Environment NRENEL, Vol. 4, No. 1, p 16-18, 51-52, Spring 1989.

Descriptors: *Groundwater pollution, *Water pollution control, *Administrative regulations, *Pesticides, *Aldicarb, Pollutants, Contamination.

Growing concern about the potential pesticide contamination of groundwater, has prompted the EPA to develop a comprehensive plan for addressing the issue. EPA has made substantial progress in articulating the general philosophy of its program and striking an approach under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) with the flexibility needed to prevent over or underregulation of pesticides in different localities with widely varying groundwater characteristics and agricultural practices. The strategy calls for preventing contamination through a combination of uniform national measures (such as restrictions on the manner in which a product may be used), geographically variable use restrictions imposed by EPA, and state management plans. EPA views the states as playing a critical role in providing the necessary flexibility to take unique local conditions into account and to guard against the over or underprotection that would inevitably occur if cancellation or use restriction decisions were to be made solely on a national basis. The first specific application of the proposed strategy will be with respect to the pesticide aldicarb. The aldicarb pro-

posal tracks the general outlines of the proposed groundwater strategy, containing a mix of uniform, nationally applicable label revisions, EPA imposed but geographically limited requirements, and a requirement that state management plans be developed for highly vulnerable areas. The success of this new approach will depend on the ability of EPA and the states to solve the practical, legal, and procedural problems that will surface as EPA's attention turns from the broader goal-setting of the proposed groundwater strategy to specific efforts to achieve those goals for individual pesticides. The aldicarb proposal has highlighted some of these problems. (Gadsby-PTT)
W90-01191

**WATER QUALITY ANTIDEGRADATION: THE COLORADO EXPERIENCE.**
J. G. Laitos.
Natural Resources and Environment NRENEL, Vol. 4, No. 1, p 19-22, 52,ng 1989.

Descriptors: *Water quality, *Water quality control, *Administrative regulations, *Degradation, *Colorado.

Although water quality antidegradation theory is a desirable abstract goal, it is quite another matter to translate it into a workable, predictable, administratively practical rule. An antidegradation rule typically is triggered when the existing quality of a water body is better than the quality required to support the classified use of that water body. After months of controversy, the Colorado Water Quality Control Commission recently adopted a revised antidegradation rule and procedures for implementation. The colorado experience is illustrative of the legal and practical difficulties involved when a state agency seeks to formulate an enforceable antidegradation policy. EPA has formulated a three tier system for protecting high quality waters, and the states must implement this three tier system or risk EPA imposing on the recalcitrant state an EPA antidegradation policy. The task for the state is to interpret and implement this three tier federal antidegradation policy. (Gadsby-PTT)
W90-01192

**ANOTHER PERSPECTIVE ON COLORADO'S NEW ANTIDEGRADATION RULE.**
M. Kassen.
Natural Resources and Environment NRENEL, Vol. 4, No. 1, p 23-25, 53,ng 1989.

Descriptors: *Water quality, *Water quality control, *Degradation, *Colorado, *Administrative regulations.

In June 1988, the Colorado Water Quality Control Commission adopted an antidegradation rule to replace its existing antidegradation standard. The commissions action resulted from two things: a series of letters from Environmental Protection Agency Region VIII personnel indicating that Colorado's standard did not comport with federal law and a lawsuit against EPA filed by the Environmental Defense Fund and Natural Resources Defense Council and joined by Sierra Club and the Wilderness Society to adopt a federal antidegradation standard for the state. Ultimately the commission failed to adopt a sufficient rule because of its enormous effort to satisfy, at least in part, all parties to the proceeding. In attempting to give every faction something, the commission adopted a rule which strains in too many directions. Even if the new rule were to work, it still is not likely to result in protection of all of Colorado's high quality waters consistent with the federal policy. (Gadsby-PTT)
W90-01193

**NEW CLEAN WATER ACT TOXICS CONTROL INITIATIVES.**
D. M. Heineck.
Natural Resources and Environment NRENEL, Vol. 4, No. 1, p 10-12, 49-50, Spring 1989.

Descriptors: *Legislation, *Water pollution control, *Water quality, *Water quality standards, *Water control, *Pollutants, Toxicity, Water Quality Act.

There are two major themes underlying the Water Quality Act of 1987. First, the amendments reflect a concern with toxic water pollutant problems that remain despite attainment of technology-based controls. Second, the primary responsibility of states for implementing water control programs has been re-emphasized. The 1987 amendments detail a series of requirements and deadlines aimed at focusing substantial additional progress toward controlling toxic pollutants within the next few years. The new requirements of the Act concerning toxics controls will result in discharge permit limits that are more stringent than technology-based guidelines alone would require. In addition, these requirements are likely to generate new efforts by state toward nonpoint source pollution control. Two provisions having the greatest practical impact are new sections 303(c)(2)(B) and 304(1). These sections deal respectively with state water quality standards for toxics and timetables for meeting such standards. Section 303 states that whenever states review or revise their water quality standards, they will generally be required to adopt all of the specific numerical criteria for toxic pollutants that EPA has published under section 304(a) and where the EPA has not yet adopted numerical criteria for particular toxics, states are to adopt criteria on biological monitoring, often referred to as whole effluent toxicity. Section 304 requires states to develop lists of impaired waters, to identify the point sources that are responsible for toxic impacts on those waters, and to prepare individual control strategies for those point sources. (Gadsby-PTT)
W90-01194

**SDWA STANDARD: A FRAMEWORK FOR GROUNDWATER CLEANUP.**
S. I. Gutter.
Natural Resources and Environment NRENEL, Vol. 4, No. 1, p 3-5, 47-48, Spring 1989.

Descriptors: *Groundwater pollution, *Water pollution control, *Superfund, *Pollutants, Cleanup, Contamination, Legislation.

Although the Comprehensive Environmental Response, Compensation and Liability Act (Superfund) is eight years old, debates still surround some of the most basic tenets of the program, especially the definition of clean. The debate thus far has focused on which Safe Drinking Water Act (SDWA) contaminant levels to use as groundwater cleanup standards, maximum contaminant level goals (MCLGs) or maximum contaminant levels (MCLs). The distinction between the two types of contaminant levels is not especially important for noncarcinogens: affordable technology generally exists to remove noncarcinogens from water to levels considered safe by EPA, so the MCLs and MCLGs for noncarcinogens are usually the same number. However, the distinction is critical for carcinogens. Most toxicologists believe that it is not possible or appropriate to define a level below which it can be assumed that an identified carcinogen does not induce cancer. EPA's emphasis on MCLs would appear to be a move toward more practical cleanup remedies, at least when compared with the alternative of adopting MCLGs as cleanup standards. But new questions are emerging that may require a fresh look at the appropriateness of using either set of contaminant levels as cleanup standards. This discussion suggests two possible courses of action. First clients who normally might pay little attention to standard setting under SDWA must consider getting involved in those rule making decisions. Second, practitioners attempting to influence cleanup decisions at Superfund sites must continually point out the differences between standards set under the SDWA and the realities of groundwater cleanup at the site. (Gadsby-PTT)
W90-01195

**ACID RAIN OVER THE UNITED STATES AND CANADA: THE D.C. CIRCUIT FAILS TO PROVIDE SHELTER UNDER SECTION 115 OF THE CLEAN AIR ACT WHILE STATE ACTION PROVIDES A TEMPORARY UMBRELLA.**
C. Garland.
Boston College Environmental Affairs Law Review BCERDX, Vol. 16, No. 1, p 1-37, 1989. 270 ref.

Descriptors: *Acid rain, *Rainfall, *Water pollution sources, *Legal aspects, *Environment, Geohydrologic boundaries, Acids. Acidity, Water pollution control, Atmospheric water, Air pollution, Fallout, Deposition, Sulfuric acid, Ecosystems.

Acid rain as a transboundary pollution problem affecting Canada and the United States is addressed. International agreements have, so far, been unsuccessful. This article probes why there is a wait for controls and solutions for acid rain. The formation of acid rain from the oxidation of sulfur dioxide and nitrogen oxides in the atmosphere is explained, as is the 'finger-printing' method of tracing deposition chemicals to their sources. Effects of acid rain on aquatic and terrestrial ecosystems, humans and building materials are also covered. The majority of the article is devoted to proving the ineffectiveness of the Clean Air Act. Events leading to the case between New York state and EPA Administrator Lee Thomas are presented. The EPA lost the court decision to New York, and their appeal in the D.C. Circuit Court is analyzed according to various sections of the Clean Air Act. The rules proposed by Minnesota and several other states to protect the environment from acid deposition emphasize the need for more cooperation between the U.S. and Canada and use of already written laws. (Male-PTT)
W90-01264

**BUILDING A BETTER WETLAND.**
Rivertech, Inc., Laguna Hills, CA.
H. Nouri.
Civil Engineering (ASCE) CEWRA9, Vol. 59, No. 8, p 45-46, 1989. 1 fig.

Descriptors: *California, *Wetland restoration, *Urban planning, *Urbanization, *Wetlands, *Water management, *Los Angeles, Flood control, Storm runoff, Aquatic habitats, Marshes, Flow channels, Flow regulators.

Urbanization has been suggested to preserve the 216 degraded acres of the Ballona Wetlands, located west of Los Angeles. The proposed plan combines development with a restoration program run by the National Audubon Society. Owners of the wetlands are providing the National Audubon Society with an estimated $10 million to restore and maintain the area. An environmental education center is planned, as are improved nesting habitats for endangered species and a combined freshwater/saltwater marsh area. Developers and engineers created a hydrodynamic computer model to predict wetland response to various water levels. Computer-operated gates will regulate flow rates and control water levels to restore tidal ebb and flow. Saltwater amounts will also be regulated by the hydrodynamic computer model, allowing some freshwater areas to encourage diverse speciation. The freshwater system may also take in water from the flood control channel, which was not viewed as a problem. The devised system can handle storm runoff with a two year recurrence interval; excess will go into the wetland until discharged via Ballona Creek is allowable. Work pends approval of the plan by the California Coastal Commission. (Male-PTT)
W90-01265

**BIOREMEDIATION: TESTING THE WATERS.**
Woodward-Clyde Consultants, Oakland, CA.
M.R. Piotrowski.
Civil Engineering (ASCE) CEWRA9, Vol. 59, No. 8, p 51-53, 1989. 2 fig.

Descriptors: *Groundwater pollution, *Water pollution treatment, *Bioremediation, *Creosote, Cost analysis, Aquifers, In situ treatment, Dissolved oxygen, Organic compounds, Chlorinated hydrocarbons, Lumber industry.

The task of purifying groundwater of organic contaminants is becoming easier thanks to recently

developed self-cleaning aquifers and the technique called in situ bioremediation. The new technique stimulates underground microbes to metabolize contaminants, thus destroying the material altogether. The pilot study test site was an active lumber mill in an alluvial valley of Montana which was placed onto the Superfund list in 1983. Two aquifers were beneath the site, and soil and groundwater were contaminated by pentachlorophenol (PCP), creosote, wastes and sludge. The study focused on the upper aquifer, where risk to human and environmental health due to the contaminants was greatest. A feasibility study comparing groundwater quality in the contaminant plume and pristine aquifer upgradient areas was conducted first. Results showed that concentrations of dissolved oxygen became reduced as groundwater passed through the contaminated area. This was due to microorganisms that consumed available oxygen as they metabolized the PCP and creosote. Hydrogen peroxide was injected into the contaminant plume to increase the concentration of dissolved oxygen. Improved oxic conditions following the hydrogen peroxide injection coincided with reduced contaminant concentrations. Full scale treatment with this method includes extraction and treatment of heavily contaminated groundwater and excavation of soils. This full scale treatment is proposed to take less time and millions of dollars less money than commonly used technologies. (Male-PTT)
W90-01266

**ACID RAIN REGULATION: FEDERAL FAILURE AND STATE SUCCESS.**
Hamline Univ., St. Paul, MN.
M. K. Roberts.
Virginia Journal of Natural Resources Law VOIKAR, Vol. 8, No. 1, p 1-74, 1988. 288 ref, 11 append.

Descriptors: *Water pollution control, *Air pollution control, *Legislation, *Legal aspects, *Acid rain, *Rainfall, *Water pollution sources, Geohydrologic boundaries, Atmospheric water, Air pollution, Fallout, Deposition, Sulfuric acid, Ecosystems, Nitrogen compounds, Governmental interrelations.

A comprehensive review of acid rain regulation attempts to urge Congress to act on test results in order to help the state-by-state movement of acid rain control. States have led in acid deposition control, but many do not have the resources to mandate emission reductions. Nationwide standards, not further studies, are needed for cooperation among states to reduce emissions from large polluters. Sources and effects of acid rain are explained, as are the government actions to date-the Clean Air Act, state implementation plans, the Federal Acid Precipitation Program, and subsequent congressional action and the Lewis-Davis Report. Minnesota's case is detailed by way of background information, lawmaking, designation of sensitive areas, the acid deposition standard and control plan hearing. A critique of the process and suggestions for improvement are included. Achievement of meaningful reductions will require the cooperation of all the states, particularly the large polluters, in reducing emissions. Appropriate federal control is the most efficient and equitable long-term solution. (Male-PTT)
W90-01275

**PHOSPHORUS RELEASE FROM A HYPERTROPHIC LAKE SEDIMENT: EXPERIMENTS WITH INTACT SEDIMENT CORES IN A CONTINUOUS FLOW SYSTEM.**
National Environmental Research Inst., Silkeborg (Denmark).
M. Sondergaard.
Archiv fuer Hydrobiologie AHYBA4, Vol. 116, No. 1, p 45-59, Jul 1989. 5 fig, 2 tab, 33 ref.

Descriptors: *Water pollution sources, *Lake restoration, *Limnology, *Cycling nutrients, *Lake sediments, *Phosphorus, Continuous flow system, Temperature, Lake Sobygaard, Denmark.

Aerobic P release from the sediment of shallow and hypertrophic Lake Sobygaard, Denmark was investigated in experiments with intact sediment cores. Cores were incubated in a continuous flow system at variable temperatures. After the experiments, the cores were segmented and P was fractionated to determine the origin of the released P. P release rates were temperature dependent in the order of 100-200 mg P/sq m/day at typical summer temperatures. These gross release rates have been supported by other investigations. P was released from the loosely sorbed and iron bound fractions. Organic bound P is also considered to be important for the overall flux of P in the sediment, especially during the summer when a large proportion of the released P due to algal sedimentation is returned to the sediment as organic bound P. P was mainly released from 2-6 cm depth; the upper 1-2 cm of the sediment seem to be in a state of equilibrium and did not release P. (Author's abstract)
W90-01301

**FILTRATION RATE OF DREISSENA POLYMORPHA (BIVALVIA) IN THREE DUTCH LAKES WITH REFERENCE TO BIOLOGICAL WATER QUALITY MANAGEMENT.**
Instituut voor Cultuurtechniek en Waterhuishouding, Wageningen (Netherlands).
H. H. Reeders, A. Bij de Vaate, and F. J. Slim.
Freshwater Biology FWBLAB, Vol. 22, No. 1, p 133-141, August 1989. 5 fig, 1 tab, 29 ref.

Descriptors: *Mussels, *Filtration, *Eutrophic lakes, *Limnology, *Lake restoration, *Water quality management, Dreissena, Water temperature, Seasonal variation, Lake IJsselmeer, Lake Markermeer, The Netherlands.

The filtration rate of Dreissena polymorpha measured in the field in three shallow Dutch lakes shows an inverse exponential relationship with the dry matter content of the water. Temperature seems to set only a gross level to the filtration rate in summer and winter season; within a season no clear relation between the filtration rate and temperature exists. Under laboratory conditions the risk of measuring abnormal behavior of D. polymorpha is shown to be substantial; hence field-measurements of the filtration rate are preferable. The clearing capacity of the D. polymorpha populations in Lakes IJsselmeer and Markermeer is sufficient to filter both lakes at least once or twice a month. This indicates the potential importance of this species for restoration of turbid, eutrophic lakes by means of biomanipulation. (Author's abstract)
W90-01323

**IMPLEMENTATION STRATEGIES FOR SALINITY PROJECTS.**
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
D. G. Fontane, J. W. Labadie, B. Loftis, and D. H. Merritt.
Journal of Water Resources Planning and Management (ASCE) JWRMD5, Vol. 115, No. 5, p 671-683, September 1989. 6 fig, 19 ref, append.

Descriptors: *Water pollution control, *Salinity control, *Saline water systems, *Resources management, *Project planning, *Evaluation, Sensitivity analysis, Construction costs, Dynamic programming, River basins, Colorado.

The U.S. Bureau of Reclamation has the responsibility for developing implementation strategies for salinity control projects in the Colorado River Basin. Determining when and which projects should be built depends primarily upon the planning and construction funds available at various times during the program period and other considerations. The Bureau of Reclamation uses a methodology for analyzing implementation strategies for salinity control projects in the Colorado River Basin which uses a variant of the more traditional dynamic programming formulations of the capacity expansion problem, allowing total project costs to be used as the state variable. Objective-space dynamic programming was used to efficiently develop multiple solutions for a range of possible funding levels for the life of the program. The solutions allow the evaluation of the sensitivity and effects of various funding scenarios on the overall salinity control program. Examples of the information determined by the methodology and the types of sensitivity analysis that can be conducted have been developed. (Author's abstract)
W90-01351

**STUDY OF WATER QUALITY IN AN URBAN RIVER AND POTENTIAL IMPROVEMENT USING A PROTOTYPE INSTREAM AERATOR.**
Urban Systems Ltd., Kamloops (British Columbia).
For primary bibliographic entry see Field 5B.
W90-01366

**POLLUTION CONTROL LAWS AGAINST PUBLIC FACILITIES.**
M. R. Gelpe.
Harvard Environmental Law Review HELRDC, Vol. 13, No. 1, p 69-146, 1989.

Descriptors: *Water pollution control, *Legal aspects, *Environmental policy, *Environmental protection, *Law enforcement, Wastewater facilities, Effluents.

An examination of remedies imposed against publicly owned treatment works (POTWs) and other public facilities for violations of pollution control laws is presented. There is a wide variety of environmental legislation which regulates the conduct of public facilities, but most administrative action and litigation has concerned the pollution of water by sewage treatment plant effluents. The topics discussed include: (1) Statutory framework and causes of noncompliance; (2) Findings on remedies; and (3) Funding systems. The lack of vigorous enforcement of pollution control laws against public facilities is not due to lack of legal authority but to the failure of the responsible administrative agencies and the courts to use the full extent of their authority. Agencies and courts should regularly impose civil penalties for both past and foreseeable future violations of pollution control laws, and should always back up their compliance orders with a schedule of stipulated penalties. The enforcement law itself is largely adequate. The only change that is needed is to authorize all state agencies to impose modest administrative penalties. This power, if used wisely, will conserve enforcement resources by avoiding costly and time-consuming litigation. (White-Reimer-PTT)
W90-01372

**AQUATIC HUMIC SUBSTANCES: INFLUENCE ON FATE AND TREATMENT OF POLLUTANTS.**
For primary bibliographic entry see Field 5B.
W90-01491

**INTERACTIONS OF HAZARDOUS-WASTE CHEMICALS WITH HUMIC SUBSTANCES.**
Missouri Univ., Columbia. Dept. of Chemistry.
For primary bibliographic entry see Field 5B.
W90-01497

**CATALYTIC-COMPETITION EFFECTS OF HUMIC SUBSTANCES ON PHOTOLYTIC OZONATION OF ORGANIC COMPOUNDS.**
Illinois State Water Survey Div., Champaign.
G. R. Peyton, C. S. Gee, J. Bandy, and S. W. Maloney.
IN: Aquatic Humic Substances: Influence on Fate and Treatment of Pollutants. American Chemical Society, Washington, DC. 1989. p 639-661, 15 fig, 31 ref.

Descriptors: *Water pollution treatment, *Ozonation, *Humic acids, *Organic compounds, Free radicals, Kinetics.

During the treatment of organic compounds in water with free-radical processes such as photolytic ozonation, humic substances are expected to compete with the target compound for hydroxyl radicals. Experimental studies were performed on the competitive effect of macromolecular humic

substances during photolytic ozonation and H2O2-UV treatment of a model pollutant compound. None of the humic substances interfered as effectively with the photolytic ozonation of diethyl malonate as was expected from an estimate of the hydroxyl radical reaction rate constant based on the molecular weight of the humic substances and from the competitive behavior of polyethylene glycols in a similar molecular weight range. The apparent noncompetitive behavior of the humic substances implies the production of secondary species that catalyze the generation of additional hydroxyl radical from ozone and thus counteract the competitive effect. (See also W90-01491) (Author's abstract)
W90-01527

**CHARACTERIZATION OF THE RIVER AND DRINKING WATER QUALITY OF A GREAT CITY.**
Timisoara Water Board (Romania).
E. A. Lorinczi.
IN: Hydrological Processes and Water Management in Urban Areas. Proceedings of the International Symposium 24-29 April 1988, Duisburg, West Germany. International Hydrological Programme of UNESCO Publication, 1988. p 143-151, 3 fig, 1 tab, 3 ref.

Descriptors: *Urban hydrology, *Water pollution control, *Water quality control, *Drinking water, *Timisoara, *Romania, Pesticides, Water treatment, Water pollution, Potable water.

Results of recent research has shown that there is no alarming pollution of the river water used as raw material for the drinking water supply of Timisoara, Romania. In fact, the quality of surface water is continually increasing. But some heavy metals have been detected, with values well under the admitted limits. Acceptable values for organochlorine pesticides, and some organic substances with molecular weights over 1000 g/Mol have also been detected. Because of the presence of some pesticides in the drinking water (all below permitted limits given in national and international standards) some technological measures are necessary for the improvement of the drinking water quality. This is made by interdisciplinary application research. Present day conditions require an analytical determination of more persistant and toxic substances, which could be harmful for the safety and quality of the water. For special situations--accidental pollution or drought periods with minimal water discharge--preventive measures have been stipulated to prevent their negative influence on downstream use, concomitantly with setting up a daily monitoring and timely notice of every unusual change. (See also W90-01612) (Lantz-PTT)
W90-01628

**MANAGEMENT OF AVAILABLE WATER RESOURCES AS A BASIS FOR POLLUTION CONTROL AND RATIONAL USE.**
Niedersaechsisches Landesamt fuer Wasserwirtschaft, Hildesheim (Germany, F.R.).
I. J. Schilling.
IN: Hydrological Processes and Water Management in Urban Areas. Proceedings of the International Symposium 24-29 April 1988, Duisburg, West Germany. International Hydrological Programme of UNESCO Publication, 1988. p 169-176, 2 fig, 2 tab, 6 ref.

Descriptors: *Water management, *Water quality control, *West Germany, Management planning, Urban areas, Water use, Policy making, Water resources development.

Water management plans as laid down in paragraph 36 B of the Water Resources Policy Act, Federal Republic of Germany, are suitable instruments for coordinating many competing demands on the water supply. They take into account economic and ecological relationships and aim to achieve the maximum benefit for the general public especially in densely populated urban regions. Fundamental elements of water management plans are the collection of the necessary data and the resulting usage catalogue. Such as catalogue enables a comparison to be made between the usage based on the present state of the water and existing or planned demands, so that the key management requirements may be determined. It is suggested that four usage classes be established for management plans, based on a combination of individual usages and functions which make common demands in respect of water quality; the suggestion is then illustrated with concrete examples from Lower Saxony. In urban areas the question arises as to whether and how the usage of the available water resources, which are not normally extendable, is feasible, can be extended at times of minimum flow. Since the demand for the available water almost always arises out of a number of different natural and social functions it is necessary to balance these against each other on the one hand and the obligation to protect the environment on the other. This process can be placed in a concrete framework by the establishment of threshold values. Possible means of determining and implementing such threshold values are presented and discussed. (See also W90-01612) (Author's abstract)
W90-01631

**SURFACE AND GROUND WATER USE IN THE URBAN AREA OF ZAGREB.**
For primary bibliographic entry see Field 5F.
W90-01633

**SEPARATE AND COMBINED SEWERS--EXPERIENCE IN FRANCE AND AUSTRALIA.**
New South Wales Inst. of Tech., Broadway (Australia).
For primary bibliographic entry see Field 5F.
W90-01635

**TRANSPORT OF SUSPENDED SOLIDS IN SEWERS.**
Witteveen and Bos, Deventer (Netherlands).
For primary bibliographic entry see Field 5D.
W90-01636

**TOWARDS COMPLETE INTEGRATION OF WATER QUALITY ASPECTS IN URBAN WATER MANAGEMENT DESIGN.**
Witteveen and Bos, Deventer (Netherlands).
For primary bibliographic entry see Field 5D.
W90-01637

**TOWARDS A SPECIFIC APPROACH OF URBAN HYDROLOGY IN AFRICA.**
Montpellier-2 Univ. (France).
M. Desbordes, and E. Servat.
IN: Hydrological Processes and Water Management in Urban Areas. Proceedings of the International Symposium 24-29 April 1988, Duisburg, West Germany. International Hydrological Programme of UNESCO Publication, 1988. p 231-237, 1 tab, 7 ref.

Descriptors: *Urban hydrology, *Africa, *Management planning, *Water management, Developing countries, Storm water, Economic aspects, Urban drainage, Drainage systems, Research priorities.

Fast urban growth in Africa has lead to serious urban drainage problems that cannot always be solved by means of simple technical transfers from developed countries. A specific approach to urban hydrology in Africa is urgently needed, but cannot be efficiently formulated by only studying some specific aspects of African hydrological processes. It must also involve proposals for technical solutions which could be adapted to local socio-economic conditions, and the fact that urban storm drainage is a major factor to consider when designing the land uses in African cities. New drainage facilities used in developed countries should be taken as references, but specific research must still be performed in order to choose which facility is in agreement with socio-economic conditions in African cities. To further this research the Interafrican Center for Hydraulics Studies (CIEH), in Ouagadougou (Burkina Faso) is being developed. It is a research program related to urban storm drainage. Data from experimental catchments in different West and Center Africa cities are analyzed, and it has already been found that African urban runoff must be specifically modeled. Future research will concern the technical and socio-economic survey of some urban storm drainage equipment. (See also W90-01612) (Lantz-PTT)
W90-01638

**URBAN DRAINAGE IN PARAMARIBO, SURINAME.**
Ministry of Public Works, Telecommunications and Construction, Paramaribo (Surinam).
For primary bibliographic entry see Field 5D.
W90-01639

**DUTCH NATIONAL RESEARCH PROGRAMME ON SEWERAGE AND WATER QUALITY.**
M. K. H. Gast.
IN: Hydrological Processes and Water Management in Urban Areas. Proceedings of the International Symposium 24-29 April 1988, Duisburg, West Germany. International Hydrological Programme of UNESCO Publication, 1988. p 247-255.

Descriptors: *Research priorities, *Water quality control, *Water pollution sources, *Water pollution control, *Water pollution effects, *The Netherlands, Chemical oxygen demand, Suspended solids, Rainfall-runoff relationships, Organic compounds.

In the year 1983, the Dutch Ministry of Housing, Physical Planning, and Environment and the Research Centre of the Dutch Water Authorities founded a National Research Committee for Sewerage and Water Quality (NWRW). The NWRW was allocated a budget of Fdl. 12,800,000--to carry out a research program on the relationship between sewerage systems and surface water quality. The NWRW was founded for a period of 5-6 years. In the Netherlands much effort had been put into sewerage and the construction of sewage treatment plants since 1965. Nevertheless, surface water quality had not improved as much as expected. A large amount of factual material has been obtained from this research program. Results include: (1) variations in heavy storm occurrences across the country amount to approximately 6%. These differences are too small to be taken into account in designing sewerage systems; (2) an overflow event in practice deviates considerably from the theoretical overflow event based on hydrological and hydraulic figures; (3) showers which should give rise to overflow do not have this effect in practice, and vice versa. The total result is that 10%-25% more overflows occur that were calculated in theory; (4) the length of the preceding dry weather period has little or no effect on the pollution per overflow. The investigations in flat areas have shown no first-flush effect; (5) water from roofs may be contaminated by polycyclic aromatic hydrocarbons, lead and zinc, while from other surfaces there is pollution by oil, suspended solids (SS), chemical oxygen demand (COD), nitrogens and micro-pollutants; (6) the effect of stormwater sedimentation tanks shows an average reduction of 60%-70% for COD and SS. The COD reduction of a swirl concentrator was estimated at 40%. Results of the measurements on a high weir are not yet available; and (7) the impact of pollution from sewerage systems on receiving waters depends on the type of these waters. In small ponds, color, scent, coarse waste, foam, etc. indicate an overflow. (See also W90-01612) (Lantz-PTT)
W90-01640

**APPROPRIATE TECHNOLOGY FOR URBAN DRAINAGE IN DEVELOPING COUNTRIES.**
Technische Univ. Muenchen (Germany, F.R.). Lehrstuhl fuer Wassergutewirtschaft und Gesundheitsingenieurwesen.
W. F. Geiger.
IN: Hydrological Processes and Water Management in Urban Areas. Proceedings of the International Symposium 24-29 April 1988, Duisburg, West Germany. International Hydrological Programme of UNESCO Publication, 1988. p 257-268,

1 tab, 5 ref.

Descriptors: *Water quality control, *Water management, *Urban drainage, *Developing countries, Public policy, Drainage systems, Wastewater treatment.

Appropriate sanitation and storm drainage is necessary especially in urbanized areas to prevent the spread of waterborne diseases. The choice of drainage system depends on meteorological conditions and is influenced by social and cultural conditions, as well as by financial and administrative constraints. A master plan should be the first step toward an urban drainage system. This is a general technical layout plan of the sanitation and storm drainage system for an entire urban area. Such a plan indicates the existing conditions as well as different future development and implementation stages up to the planning horizon. Drainage systems must be designed that they can be constructed in steps and maintained with the funds available. Drainage systems, however, can be operated successfully only if at the same time, sufficient services for solid waste removal are provided. Furthermore, public information and education programs explaining advantages of these systems and disadvantages of their misuse should lead to the acceptance of these new approaches and guarantee their feasibility. Participation of local residents in the control and maintenance work is considered very helpful. (See also W90-01612) (Lantz-PTT)
W90-01641

**INTEGRATED MEASURES FOR THE REDUCTION OF STORM WATER AND COMBINED SEWER OVERFLOW IMPACT ON AN URBAN LAKE.**
Aalborg Universitetscenter (Denmark). Environmental Engineering Lab.
T. Hvitved-Jacobsen, and S. Jensen.
IN: Hydrological Processes and Water Management in Urban Areas. Proceedings of the International Symposium 24-29 April 1988, Duisburg, West Germany. International Hydrological Programme of UNESCO Publication, 1988. p 283-294, 6 fig, 5 tab, 3 ref.

Descriptors: *Wastewater treatment, *Wastewater management, *Storm water, *Sewers, *Urban drainage, *Combined sewer overflows, Phosphorus, Overflow, Urban areas, Viborg, Denmark, Rainfall-runoff relationships, Drainage systems.

For two years, an intensive monitoring program was carried out in order to establish a basis for a wastewater management plan for the city of Viborg, Denmark. In this plan special attention is paid to reducing the impact of storm water runoff (SWR) and combined sewer overflows (CSO) from the 506 hectare (ha) paved drainage area of the city on an urban twin-lake of 266 ha. Based on the results of the investigation, a wide variety of both structural and non-structural measures will be implemented during a five year planning period, which started in 1987, based on a financial plan which amounts to $12 million. In the attempt to reduce the impact of CSO on the lake, special attention was paid to evaluating possible negative effects of the increased hydraulic load on the wastewater treatment plant. Exemplified by phosphorus, the total nonpoint urban loadings on the twin-lake will be reduced from 0.35 to about 0.16 g/sq m/yr during the planning period. (See also W90-01612) (Author's abstract)
W90-01643

**EFFICIENCY OF STORM WATER SEDIMENTATION TANKS INCORPORATED IN DUTCH SEWERAGE SYSTEMS.**
DHV Consulting Engineers, Amersfoort (Netherlands).
For primary bibliographic entry see Field 5D.
W90-01647

**EFFECT OF UTILIZATION OF GEOTHERMAL WATERS ON THE DISCHARGE AND TREATMENT OF MUNICIPAL WASTE WATERS.**
Vyskumny Ustav Vodohospodarsky, Bratislava (Czechoslovakia).
For primary bibliographic entry see Field 5D.
W90-01648

**RECENT TRENDS IN THE REAL TIME CONTROL OF URBAN DRAINAGE SYSTEMS.**
Hanover Univ. (Germany, F.R.). Inst. fuer Grundbau, Bodenmechanik und Energiewasserbau.
For primary bibliographic entry see Field 5D.
W90-01649

**COMBINED SEWER OVERFLOW ABATEMENT BY ON-SITE DETENTION, INFILTRATION, AND RE-USE.**
Hanover Univ. (Germany, F.R.). Inst. fuer Grundbau, Bodenmechanik und Energiewasserbau.
For primary bibliographic entry see Field 5D.
W90-01650

**MACROINVERTEBRATE BIOMONITORING AND WATER QUALITY MANAGEMENT WITHIN URBAN CATCHMENTS.**
Middlesex Polytechnic, Enfield (England). Urban Pollution Research Center.
For primary bibliographic entry see Field 5A.
W90-01657

**INTEGRATED METHODOLOGIES FOR THE CONTROL OF URBANIZATION EFFECTS ON GROUNDWATERS IN THE PALERMO AREA (SICILY).**
Palermo Univ. (Italy). Ist. di Geofisica Mineraria.
A. Cimino.
IN: Hydrological Processes and Water Management in Urban Areas. Proceedings of the International Symposium 24-29 April 1988, Duisburg, West Germany. International Hydrological Programme of UNESCO Publication, 1988. p 413-420, 3 fig, 9 ref.

Descriptors: *Water pollution control, *Urban areas, *Water management, *Groundwater quality, Water quality control, Sicily, Management planning, Groundwater management, Palermo.

In the last 15-20 years, a large area surrounding Palermo has undergone a relatively sharp change from agriculture to urban development. As socio-economic factors, a rising industry and the multiplication of public bodies have caused a rapid process of local immigration from inland zones--cities are expanding, creating a large number of environment problems. Recent work has dealt with the quality and quantity of water, and its deterioration. This paper shows the 'state of the art' of the situation, resuming efforts carried out by the University of Palermo, and other projects, to control groundwaters by means of integrated methodologies. Geophysical and geochemical surveys have been usefully applied to follow deterioration phenomena in circumscribed 'risk' sectors of the Palermo area as well as for the whole plane. As a result of field and interpretation works, suggestions are made for the rational utilization of the Palermo groundwaters, taking into account the development provisions and subsequent planning of the hydraulic resources. (See also W90-01612) (Author's abstract)
W90-01658

**INFLUENCE OF INDUSTRIALIZATION AND HYDROGEOLOGY ON THE QUALITY OF GROUND AND SURFACE WATER IN BIELEFELD (CASE STUDIES).**
For primary bibliographic entry see Field 5B.
W90-01659

**EFFECTS OF URBANIZATION ON WATER RESOURCES IN THE WATERFORD RIVER BASIN.**
Newfoundland Dept. of the Environment, St. John's.
For primary bibliographic entry see Field 4C.
W90-01674

**URBAN WATER QUALITY IN RELATION TO COMBINED SEWER OVERFLOW AND STORMWATER RUN-OFF IN AMSTEL- EN GOOILAND.**
Amstel- en Gooiland Water Pollution Control Authority, Hilversum (Netherlands).
For primary bibliographic entry see Field 4C.
W90-01675

**WASTE WATER IRRIGATION SUITED TO THE ENVIRONMENT AS SHOWN BY THE EXAMPLE OF THE 'ABWASSERVERBAND WOLFSBURG'.**
Technische Univ. Braunschweig (Germany, F.R.). Inst. fuer Geologie.
For primary bibliographic entry see Field 3C.
W90-01679

**RE-NATURATION OF WATERCOURSES IN THE NORTH RHINE-WESTPHALIAN INDUSTRIAL REGION.**
Emschergenossenschaft und Lippeverband, Essen (Germany, F.R.).
I. D. Londong.
IN: Hydrological Processes and Water Management in Urban Areas. Proceedings of the International Symposium 24-29 April 1988, Duisburg, West Germany. International Hydrological Programme of UNESCO Publication, 1988. p 683-690, 3 fig.

Descriptors: *West Germany, *Water pollution treatment, *Urbanization, *Urban hydrology, *Rhine River, *Industrial development, *Ecosystems, Wastewater, Water conveyance, Channels, Water quality, Groundwater quality, Springs, Flow profiles, Case studies.

In the densely inhabited West German industrial region, most watercourses between the Ruhr and Lippe Rivers fulfill a technical function as an outlet channel for storm water and wastewater. The waterways were deeply carved in the soil or made with dikes for extreme rain water flow, and with concrete bed plates for sewage flow. Ecological knowledge and new environmental requirements have, however, challenged this system. Detailed investigations have shown that under the present system of water engineering, the Emscher River and many of its tributaries cannot be transformed into biologically active watercourses in the near future. Ten years ago, the Emscher- and Lippe-Water-Associations, self-administering organizations responsible for drainage, flood protection and sewage treatment, took the first step toward returning the brook's natural character. A so-called re-naturation is possible under the following conditions: (1) an elimination of all soil subsidence occurring in the region of the brook; (2) a sufficient water quality--to achieve this, the sewage must be drained off to downstream treatment plants or purified in new decentralized plants; (3) a sufficient flow of clean water from springs or groundwater; (4) the anthropogene high water flow must be reduced; and (5) sufficient area is necessary--a natural brook needs more space than a hydraulically more efficient channel. The ecological benefit of a re-naturation depends on the development of banks and meadows. Other examples of re-naturation in this region of West Germany are presented in this paper, through case studies. (See also W90-01612) (Lantz-PTT)
W90-01688

**WATER RENT AS AN ECONOMIC INSTRUMENT FOR THE PROTECTION AND IMPROVEMENT OF WATER QUALITY FOR THE BENEFIT OF THE DRINKING WATER SUPPLY OF TOWNS.**
Technische Hochschule Aachen (Germany, F.R.).
For primary bibliographic entry see Field 6C.
W90-01693

**WATER MANAGEMENT IN URBAN AREAS OF A DEVELOPING COUNTRY.**
Dar es Salaam Univ. (Tanzania). Dept. of Civil Engineering.
For primary bibliographic entry see Field 5F.
W90-01694

**POSSIBILITIES OF ECOLOGICAL STREAM MAINTENANCE IN URBAN AREAS.**
For primary bibliographic entry see Field 4A.
W90-01696

**WATER QUANTITY MANAGEMENT IN URBANISED POLDERS.**
Department of Public Works, Amsterdam (Netherlands). Sewerage and Drainage Dept.
E. Jacobs.
IN: Hydrological Processes and Water Management in Urban Areas. Proceedings of the International Symposium 24-29 April 1988, Duisburg, West Germany. International Hydrological Programme of UNESCO Publication, 1988. p 757-765, 7 fig, 8 ref.

Descriptors: *Water supply, *Polders, *Waste management, *The Netherlands, Hydrologic budget, Economic aspects, Water storage, Urbanization, Urban areas, Urban planning.

Precipitation is the cause of a rise in the water level of the surface water in an urban polder. The height which this may obtain in a polder is determined by the sand filling. Limiting this water level rise is accomplished by sufficient use of water storage influence the cost of an urban expansion. An economic optimum for water manageable adaptation must be determined. The soil of the polders surrounding Amsterdam, The Netherlands, is mostly weak and slightly permeable. To made a sound building foundation it is necessary to raise this area by using sand. Only a small amount of settling by load application can take place during the adaptation of a residential area to avoid damage to roads, buildings, cables and piping lines. Therefore, the building of a residential area can only take place after the settling by load application is almost complete. The larger the total settling by load application, the longer it takes, and the longer the investment in the building land lies idle, bearing no interest. However, the setting up can be reduced by creating areas for water storage. When more land is reserved for water storage, there is less land available to build houses, and more revenue comes from the ground exploitation. When the relationship between the setting up and the water storage is determined, an optimal choice can be made. This is for the financial viewpoint as well as the water management control of the system. To determine this optimum, it is necessary to formulate rules whereby the system of water management and the construction of the urban expansion have a satisfactory relationship to one another. (See also W90-01612) (Lantz-PTT)
W90-01697

**WETLAND MANAGEMENT IN THE CONTEXT OF REGIONAL PLANNING, EAST CALCUTTA--A CASE STUDY.**
G. Mukherjee.
IN: Hydrological Processes and Water Management in Urban Areas. Proceedings of the International Symposium 24-29 April 1988, Duisburg, West Germany. International Hydrological Programme of UNESCO Publication, 1988. p 767-773, 1 tab, 4 ref.

Descriptors: *Water pollution control, *Wetlands, *Urban planning, *Ecological effects, Calcutta, India, Water management, Ecosystems, Public participation, Legislation, Technology transfer, Recycling.

Purposeful study of wetland ecosystems is essential in the urban fringe where wetlands are being lost due to severe settlement pressure. Even today, wetlands are too commonly considered marshy wastes fit only for reclamation or dumping. Waste recycling wetlands east of Calcutta are the largest in the world, and have a unique system for purifying sewage, growing food and generating employment. Here, fisheries are directly using raw sewage to become more efficient, effective and economically viable. The strategy being employed to preserve the Calcutta system includes: (1) protecting the east Calcutta wetlands that recycle urban waste for food, employment and sanitation; (2) ensuring drainage outfall systems to feed fisheries; (3) preserving the promoting the rural technology to recycle domestic sewage; (4) introducing or modifying legislative policies and rules; (5) developing technology transfer scheme to popularize the system and raise the level of public awareness; and (6) incorporating waste recycling progresses in development schemes. (See also W90-01612) (Lantz-PTT)
W90-01698

**WATER RESOURCES MANAGEMENT IN REGIONS WITH ENVIRONMENTAL PROBLEMS.**
Dortmund Univ. (Germany, F.R.).
For primary bibliographic entry see Field 6A.
W90-01699

**WATER MANAGEMENT PLANNING IN THE AREA 'CITY OF HANNOVER AND SURROUNDING'.**
Niedersaechsisches Landesamt fuer Wasserwirtschaft, Hildesheim (Germany, F.R.).
H. J. Schultz-Wildelau.
IN: Hydrological Processes and Water Management in Urban Areas. Proceedings of the International Symposium 24-29 April 1988, Duisburg, West Germany. International Hydrological Programme of UNESCO Publication, 1988. p 783-790, 2 fig, 1 tab, 3 ref.

Descriptors: *Water management, *Management planning, *Urban planning, *Water resources development, Ecosystems, Groundwater budget, Water supply, Hannover, West Germany.

Using the City of Hannover, West Germany, and its surroundings as an example, the typical water management problems and solutions found in many German cities are illustrated. The water management plan 'Untere Leine' has been drafted as a future plan for an area of nearly 2,500 sq km around Hannover. The aims of the plan are: (1) to maintain surface water and groundwater in a condition which renders their use now, and in the future, possible; (2) to avoid excessive exploitation of water resources so that they may continue their natural functions within the total ecosystem; (3) to protect human life and economic goods against flood damage; and (4) to reduce interference in natural processes to a minimum. A priority of the plan is the creation of a balance between the water demand (comprising the separate demands of the population, of industry and of agriculture) and the supply of usable groundwater. In order to resolve the conflict between the preservation of vital resources such as air, soil, water and biotopes, and the development ambitions of a city, strategies must be developed. The city of Hannover has applied for an ecological research program in which methods of preserving, securing and developing stable ecological systems within the city area will be worked out on an exemplary basis. The section of the plan entitled 'Water' contains the following stages: (1) collection and evaluation of data which provide a qualitative and quantitative description of the natural water household; (2) establishment of causal relationships between the fields of air, soil water, biotope and regional structure; (3) formulation of recommendations for city planning; and (4) construction of hydrographical monitoring systems with recommendations for data evaluation. (See also W90-01612) (Lantz-PTT)
W90-01700

**CO-TREATMENT OF MANUFACTURED GAS PLANT SITE GROUNDWATERS WITH MUNICIPAL WASTEWATERS.**
Gas Research Inst., Chicago, IL.
For primary bibliographic entry see Field 5D.
W90-01702

**SUPERFUND RECORD OF DECISION: ZELLWOOD, FL.**
Environmental Protection Agency, Washington, DC. Office of Emergency and Remedial Response.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-117410. Price codes: A04 in paper copy, A01 in microfiche. Report No. EPA/ROD/R04-88/031, December 1987. 44p, 3 fig, 30 tab.

Descriptors: *Cleanup, *Superfund, *Water pollution sources, *Water pollution treatment, *Zellwood, *Florida, *Landfills, Costs, Waste disposal, Cleanup operations, Organic compounds, Groundwater pollution, Heavy metals, Pesticides, Incineration, Monitoring, Water pollution control.

The 57-acre Zellwood site is located in the northwestern corner of Orange County, Florida. Situated in a rural area, the site is occupied by four industries and an open field containing a marshy wetland area. Approximately 300 homes within a one-mile radius of the site depend on private wells as their sole source of potable water. Between 1963 and 1971, Drum Service Co. of Florida, a drum recycling facility, operated wastewater disposal systems without a regulatory permit, treating and disposing of generated wastewaters in two onsite evaporation/percolation ponds. In 1980, the company eliminated the use of these ponds for waste disposal and in August 1981 initiated drainage and removal of contaminated sediments from the ponds. From 197! through 1985, the Drum Service Co. has had various types of waste treatment and disposal permits issued by the Florida Dept. of Environmental Regulation (FDER). In December 1982, EPA representatives discovered an abandoned drum storage area in the northern section of the Zellwood site. Based on unsubstantiated reports from area residents, material in this drum storage area may have been there fore more than 20 years. In the fall of 1983, EPA oversaw a removal action of the abandoned drum area. The primary contaminants of concern affecting the groundwater, soil, sediments and sludge include: organics, inorganics, metals, and pesticides. The selected remedial action for this site includes: excavation of soils and sediments with onsite incineration and testing of residuals to determine appropriate disposal; groundwater pump and treatment with flushing of the treated groundwater back through the abandoned drum area to facilitate cleanup of residual contamination; and a long-term groundwater monitoring program for private potable water wells. The estimated present worth cost for this remedial action ranges from $41,263,244 to $61,908,244 with estimated present worth operation and maintenance of $13,543,244 (excluding groundwater treatment and remediation). (Lantz-PTT)
W90-01703

**GROUNDWATER CONTAMINATION: SOURCES, CONTROL, AND PREVENTIVE MEASURES.**
Albuquerque City Enviromental Compliance Dept., NM.
C. D. Rail.
Technomic Publishing, Co., Lancaster, PA. 1989. 139p.

Descriptors: *Groundwater pollution, *Water pollution sources, *Water pollution prevention, History, Water use, Waste disposal, Water pollution control, Land disposal, Oil pollution, Industrial wastes, Farm wastes, Injection wells, Acid rain, Saline water intrusion, Water quality management.

This book is designed to provide a comprehensive, concise discussion and review of the presently known sources of groundwater contamination and its many complex interactions, including managerial and political implications. These goals are accomplished through discussions of: the historical aspects of groundwater use; the natural quality of water; on-site liquid waste disposal systems; land disposal of solid wastes and groundwater contamination; municipal, industrial, oil field wastes, and their effects on groundwater; groundwater contamination due to agricultural wastes; contamination of groundwater from disposal and injection wells; other wells as sources of contamination; underground tanks and pipeline leakage; groundwater contamination by surface waters, atmospheric precipitation, salt, and salt intrusion; contamination of groundwater in urban and suburban area, and diversion of flow structures; groundwater contamination through land surfaces; groundwater contamination--ecotoxicology and risk assessment; and groundwater contamination--its management and prevention. (Lantz-PTT)

W90-01704

**LACKAWANNA RIVER PRIORITY WATER BODY SURVEY REPORT WATER QUALITY STANDARDS REVIEW.**
Susquehanna River Basin Commission, Harrisburg, PA.
C. P. McMorran.
Susquehanna River Basin Commission, Harrisburg, PA. Publication No. 124, July 1989. 51p, 20 fig, 6 tab, 2 ref, append.

Descriptors: *Water quality control, *Water pollution sources, Water pollution prevention, Standards, Wastewater disposal, Sulfates, Iron, Lead, Manganese, Cyanide, Cadmium, Aluminum, Heavy metals, Zinc, Arsenic, Mercury, Fate of pollutants, Lackawanna River.

In 1987, Priority Water Bodies (those waters for which regulatory or control decisions are needed) were identified by the Pennsylvania Department of Environmental Resources (DER) through a series of Total Maximum Daily Load/Waste Load Allocation (TMDL/WLA) screenings. These watersheds were selected for screening on the basis of: (1) presence of a potable water supply in the watershed; (2) documentation of toxics related fish and aquatic life water quality problems in the watershed; and (3) presence of one (or more) major National Priority point discharge permits in the watershed. The screenings were conducted on a watershed basis and were designed to: (1) inventory readily available information on the nature and extent of toxics discharged from Publicly Owned Treatment Works (POTWs) and industrial discharges; (2) evaluate the potential impact that these discharges have on the receiving water body; (3) determine the parameters of concern associated with each discharge that may require water quality based effluent limitations (WQEBLs); and (4) determine where potential discharge interactions may require additional field data collection, and multiple discharge wasteload allocations. The data indicated that relationships exist between levels of toxic pollutants in the Lackawanna River and the major discharges. The Throop, Scranton and Lower Lackawanna sewage treatment plant (STP) discharges and Old Forge and Duryea mine overflows had the greatest impact on water quality in the Lackawanna River. Water quality in the Lackawanna River is impacted by high levels of sulfates, iron, lead and manganese discharged from abandoned coal mines. The sewage treatment plants discharge large amounts of lead, cyanide and cadmium. High levels of aluminum were also discharged from the Lower Lackawanna STP. Cadmium was high in discharges from Chrysler Defense, which also had high levels of cyanide, lead, iron, zinc and manganese. Arsenic, chromium and mercury were not detected and thus did not show any relationships to the discharges. (Lantz-PTT)
W90-01705

**INSTALLATION RESTORATION PROGRAM, STAGE 3; MCCLELLAN AIR FORCE BASE, SEMIANNUAL INFORMAL TECHNICAL REPORT.**
Radian Corp., Sacramento, CA.
Available from the National Technical Information Service, Springfield, VA 22161, as AD-A98 861. Price codes: A14 in paper copy, A01 in microfiche. Final Copy, September 1988. 334p, 28 fig, 20 tab, 22 ref, 4 append. USAF Project PRJY871502, Radian Contract 227-005-03.

Descriptors: *California, *Path of pollutants, *Fate of pollutants, *Groundwater pollution, *Cleanup operations, *McClellan Air Force Base, Trichloroethene, Organic compounds, Water quality control, Wells, Dichloroethene, Dichloroethane, Monitoring.

This report summarizes the interpretive results for analytical and hydrologic data obtained during groundwater sampling and analysis activities at McClellan Air Force Base, California from August 1979 through the First Quarter 1988. The data are used to evaluate the occurrence and migration of groundwater contaminants, to assess the variability in the sampling and analytical processes, to identify any hydrologic and analytical trends developing with time, and to evaluate the effectiveness of the Area D extraction system. The occurrence and migration of trichloroethene (TCE) in the groundwater was evaluated. Several factors controlling the direction of contaminant flow and the rate of contaminant migration were discussed. These include the affects of pumping by active base production wells and the Area D extraction wells. This study was able to quantify sampling variability for three compounds (TCE, 1,1-dichloroethene, and 1,1-dichloroethane). Due to date limitations, seasonal and analytical variability could not be quantified at this time. An evaluation of the Area D extraction system was conducted. Based on evaluation of analytical and hydrologic data, it is possible to conclude that the extraction system is extracting contaminated groundwater and influencing groundwater flow directions in all three monitoring zones in Area D and off base in the Northwest Area. (Author's abstract)
W90-01707

**INTERIM HYDROGEOLOGIC CHARACTERIZATION REPORT AND GROUNDWATER MONITORING SYSTEM FOR THE NONRADIOACTIVE DANGEROUS WASTE LANDFILL, HANFORD SITE, WASHINGTON.**
Westinghouse Hanford Co., Richland, WA.
D. C. Weekes, S. P. Luttrell, and M. R. Fuchs.
Available from the National Technical Information Service, Springfield, VA 22161, as DE88-011910. Price codes: A10 in paper copy, A01 in microfiche. Report No. WHC-EP--0021, October 1987. 170p, 25 fig, 4 tab, 1 plate, 31 ref, 7 append. DOE Contract DE-AC06-87RL10930.

Descriptors: *Hazardous wastes, *Monitoring, *Geohydrology, *Groundwater pollution, *Groundwater quality, *Landfills, *Water pollution control, Hydraulic conductivity, Groundwater movement, Waste disposal, Aquifers, Transmissivity, Permeability, Potable water.

A total of nine wells were installed at the Nonradioactive Dangerous Waste (NRDW) Landfill, to determine characteristics such as groundwater quality, hydraulic conductivity, and continuity of hydrostratographic units. Seven of these wells compose a detection level groundwater monitoring system that meets the requirements for interim status groundwater monitoring under 40 CFR 265, Subpart F. Groundwater flow is generally west to east across the NRDW Landfill, and the gradient is very small (about 0.1 ft/1,300 ft). The uppermost section of the aquifer is unconfined and highly transmissive. Transmissivity values range from approximately 100,000 to 300,000 sq ft/d. The hydraulic conductivity ranges from 1,700 to 5,000 ft/d, based on a saturated thickness of 60 ft. A relatively thin clayey silt unit, of low permeability, is laterally continuous under the NRDW Landfill and acts as the base of the aquifer for the purpose of monitoring potential vertical contaminant migration. Results from water samples collected from monitoring wells were compared with interim drinking water standards, and no constituent was found to exceed these standards. (Author's abstract)
W90-01708

**STATUS REPORT FOR THE HANNA AND HOE CREEK UNDERGROUND COAL GASIFICATION TEST SITES.**
University of Wyoming Research Corp., Laramie. Western Research Inst.
G. L. Berdan, B. T. Nolan, W. L. Barteaux, and W. Barrash.
Available from the National Technical Information Service, Springfield, VA 22161, as DE88-009100. Price codes: A03 in paper copy, A01 in microfiche. Report No. DOE/MC/11-76--2457, June 1987. 23p, 8 fig, 4 tab, 6 ref. DOE Contract DE-FC21-86MC11076.

Descriptors: *Water pollution treatment, *Cleanup operations, *Groundwater pollution, *Groundwater quality, *Water treatment, Adsorption, Wells, Hoe Creek, Coal gasification.

Several tasks for restoring the water quality at Hoe Creek and Hanna Creek (underground coal gasification (UCG) were completed in the past year: groundwater treatment demonstration (1986); bench-scale carbon adsorption experiments (1987); design of the scaled-up treatment system (1987); and well-pumping test (1987). A closed-loop cycle of groundwater withdrawal, treatment, and recharge was employed with batch and continuous tests. Batch test indicated that > 97% of the phenols were removed. Samples from the effluent port and the effluent surge tank contained < 20 parts per billion (ppb) phenols. Total organic carbon (TOC) removal was > 88% during the batch test (based on the TOC level in the effluent tank). Volatilization of phenols in the influent surge tank probably contributed to the removals. Phenols removals ranged from 89% to > 97% during continuous operations. Effluents typically contained < 20 ppb of phenols and < 10 parts per million (ppm) of TOC. Water levels in the production and observation wells usually stabilized after 30 minutes of pumping. The water level in the recharge well rose about 0.5 ft in a typical 9-hr pumping period. Groundwater restoration at Hanna will begin in late June 1987 and proceed through August 1987. After the 1987 groundwater restoration is completed, several tasks must be completed. All water sample results must be obtained and interpreted. The solids in the evaporation pond must be sampled, analyzed, and disposed of according to regulations. Precipitated solids will be disposed of by a subcontractor in accordance with WDEQ (Solid Waste Office) regulations. Quarterly sampling will continue to determine groundwater stability. (Lantz-PTT)
W90-01711

**SUPERFUND RECORD OF DECISION: AMERICAN THERMOSTAT, NY.**
Environmental Protection Agency, Washington, DC. Office of Emergency and Remedial Response.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-117386. Price codes: A06 in paper copy, A01 in microfiche. Report No. EPA/ROD/RO2-88/056, January 1988. 113p, 9 fig, 7 tab, 3 append.

Descriptors: *Water pollution sources, *Water pollution treatment, *Groundwater pollution, *Cleanup operations, Trichloroethene, Volatile organic compounds, Organic compounds, Drinking water, Costs, Wells, Groundwater pollution.

The American Thermostate Corporation (ATC) site, occupying approximately eight acres, is located in South Cairo, New York. Private homes are near the site on its eastern and western boundaries. Former plant operations involving the assembly of thermostats for small appliances were carried out in one existing large building. From the mid-1950s through at least 1981, waste containing to an abandoned septic system and dumped outside onto plant grounds. The drains were connected to the abandoned septic system. In March 1981, two ATC employees were observed dumping solvents on plant property. This triggered investigations into the company's waste handling practices by the New York State Department of Environmental Conservation (NYSDEC) and the New York State Attorney General's office. Subsequently, water samples collected in five privately-owned wells in the ATC vicinity revealed the presence of high levels of TCE and PCE. As a result, ATC began supplying bottled water to local residents in April 1981. Pursuant to a 1983 Consent Order, ATC and AMRO Realty Corporation (AMRO), the owners of the property, agreed to clean up the site and its surroundings; supply bottled water for cooking and drinking purposes; and install, monitor, and maintain carbon filter systems for the five affected homes. ATC and AMRO did not fully comply with the Consent Order and did not remedy the contamination at the site. In June 1983, a new onsite 4,500-gallon septic system was installed and, in September 1983, ATC provided carbon filtration for septic system discharges to lower PCE levels. EPA has installed two new carbon filtration units on contaminated private wells; installed an air stripping system on a highly contaminated well; and drilled a new well attempting to locate a clean

water supply. The primary contaminates of concern affecting the groundwater are VOCs including PCE and TCE. The selected remedial action for this site includes: extension of the existing Catskill Water District pipeline from Sandy Plains Road or from Rudolph Weir Road to the affected and potentially affected area. The exact route of the pipeline will be determined during design. The estimated capital cost for this remedial action ranges from $2,270,000 to $2,380,000 with annual operation and maintenance of $100,000 to $110,000, pending the pipeline route decision. (Lantz-PTT)
W90-01712

**SUPERFUND RECORD OF DECISION: YORK OIL COMPANY, NY.**
Environmental Protection Agency, Washington, DC. Office of Emergency and Remedial Response.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-117394. Price codes: A10 in paper copy, A01 in microfiche. Report No. EPA/ROD/R02-88/054, February 1988. 205p, 6 fig, 8 tab, 3 append.

Descriptors: *New York, *Water pollution sources, *Water pollution treatment, *Waste disposal, *Waste disposal, *Cleanup operations, Polychlorinated biphenyls, Volatile organic compounds, Phenols, Fate of pollutants, Groundwater pollution, Solidification, Costs.

The York Oil Company site, encompassing 17 acres, is located in the Hamlet of Moira, Franklin County, New York. Wetlands and woodlands are the principal land use in the vicinity of the site. The now dissolved York Oil Company operated a waste oil recycling facility from 1964 to 1977. Crankcase industrial oils, with come containing polychlorinated biphenyls (PCBs), were collected from sources throughout New England and New York, then stored and/or processed at the site in eight above-ground storage tanks, a series of three earthen-damned settling lagoons, and at least one below-ground storage tank. The recycled PCB-contaminated oil was either sold as No. 2 fuel oil or used in dust control for the unpaved roads in the vicinity of the site. During heavy rains and spring thaws, the oil-water emulsion from the lagoons would often overflow onto the surrounding lands. The York Oil site contamination was first discovered in 1979 by New York State Department of Transportation road crew, who then notified the New York State Department of Environmental Conservation (NYSDEC). Several removal actions have been undertaken at the site to contain the PCB-contamination problem. Currently, soils, sediments, groundwater, and surface water are contaminated with PCBs, VOCs, metals, and phenols. The selected remedial action for this site includes: excavation of 22,000 cu yd of contaminated soil and 8,000 cu yd of contaminated sediments with onsite solidification followed by onsite disposal of treatment residuals; installation of deep groundwater drawdown wells and shallow dewatering wells to collect the sinking contaminant plume and the oil during excavation, with onsite treatment and subsequent discharge in accordance with New York State NPDES requirements; offsite thermal treatment of approximately 25,000 gallons of contaminated tank oils in addition to other soils collected at the site; cleaning and demolition of the empty storage tanks; and grading. Treatability studies will determine the effectiveness of the solidification process and optimal treatment system for groundwater. The estimated capital cost for this remedial action is $6,500,000 with present worth operation and maintenance $500,000. (Author's abstract)
W90-01714

**SUPERFUND RECORD OF DECISION: KEEFE ENVIRONMENT, NH.**
Environmental Protection Agency, Washington, DC. Office of Emergency and Remedial Response.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-117378. Price codes: A06 in paper copy, A01 in microfiche. Report No. EPA/ROD/R01-88/024, March 1988. 164p, 3 fig, 23 tab, 4 append.

Descriptors: *Cleanup, *Water pollution sources, *Water pollution treatment, *Epping, *New Hampshire, *Chlorinated hydrocarbons, *Groundwater pollution, Drinking water, Waste disposal, Volatile organic compounds, Underground waste disposal, Volatilization, Filtration, Chemical treatment, Costs.

The Keefe Environmental Services (KES) site is located in a semi-rural area in Epping, New Hampshire. In May 1978, Mr. Paul Keefe constructed a chemical waste storage facility by establishing drum storage areas, large storage tanks, equipment shelters and a bulking area. A 700,000 gallon capacity, synthetically lined, waste lagoon was also installed. During April 1979, the New Hampshire Bureau of Solid Waste Management (NHBSWM) and the Division of Public Health Services (DPHS) ordered KES to clean up a number of leaking storage tanks, ruptured drums, improperly dumped latex waste, and contaminated soils. During September 1979, a surface water and groundwater sampling program identified seven chlorinated hydrocarbons in the groundwater wells. Beginning in November 1979, drinking water wells of the twelve surrounding residences were sampled by the New Hampshire Water Supply and Pollution Control Commission for chemical compounds and biological parameters. The sampling indicated the presence of several VOCs in some wells. Removal actions initiated between June 1981 and November 1982, and then again in March 1983, removed 2,029 fifty five-gallon drums, 84 thirty gallon drums, 47 cauldrons and trays, 51 carboys, 1,630 five gallon pails, 124 empty drums, and 10 fiber and 155 miscellaneous containers. In addition, approximately 4,100 five gallon drums, 4 five thousand gallon, and 4 ten thousand gallon above-ground tanks were removed from the site. The selected remedial action for this site includes: in-situ treatment of soil using vacuum extraction with discharge to the atmosphere; and groundwater pump and treatment using air stripping, filtration, and carbon adsorption with discharge to a groundwater recharge area adjacent to the wetland along the site border. The estimated present worth cost for this remedial action is $6,100,000 with present worth operation and maintenance of $4,157,000. (Lantz-PTT)
W90-01715

**SUPERFUND RECORD OF DECISION: EAU CLAIRE MUNICIPAL WELL, WI.**
Environmental Protection Agency, Washington, DC. Office of Emergency and Remedial Response.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-117436. Price codes: A03 in paper copy, A01 in microfiche. Report No. EPA/ROD/R06-88/064, March 1988. 46p, 5 fig, 2 tab, append.

Descriptors: *Water pollution sources, *Water pollution treatment, *Cleanup operations, *Eau Claire, *Wisconsin, *Groundwater pollution, Volatile organic compounds, Chippewa River, Dichloroethene, Organic compounds, Costs, Volatilization, Municipal water.

The 500-scre Eau Claire Municipal Well Field (ECMWF)/site is located in northwestern Eau Claire County and southwestern Chippewa County, Wisconsin, at the confluence of the Eau Claire River and the Chippewa River. ECMWF supplies drinking water to approximately 57,600 residents and numerous commercial establishments in the city of Eau Claire and Washington Township. Groundwater from five municipal wells in the north well field is contaminated with volatile organic compounds (VOCs). The contamination at the ECMWF site has been characterized as two separate plumes. The Chippewa River is not believed to be affected by this VOC contamination due to municipal well pumping which prevents groundwater discharge into the river. In March 1981, as part of the EPA Ground Water Supply Survey, the Wisconsin Department of Natural Resources (WDNR) tested the Eau Claire municipal water supply for VOCs and did not detect VOCs at levels of immediate concern. Additional testing of the city's active production wells, in January 1982, reported VOC concentrations below health advisory levels. Concerned about the future use of the water supply, additional testing in September 1982 and January 1983 was conducted to identify the source and extent of VOC contamination. Several residential wells reported detectable levels of VOCs including 1,1-dichloroethene concentrations in excess of the WDNR health advisory. The Eau Claire site was given a high Superfund National Priority List priority by WDNR due to the nature of the toxicity and persistence of the contaminants and the large population affected. The primary contaminants of concern affecting the groundwater are VOCs and include: chloroform, DCE, dichloroethene, PCE, TCE, and trichloroethane. The selected remedial action for this site includes: groundwater pump and treatment using the existing air stripper with discharge of treated water to the municipal water system and the untreated water to the Chippewa River; and provision of municipal water to private well users within or near the area of groundwater contamination. The estimated capital cost for this remedial action of $11,214,200 with annual operation and maintenance of $296,700. (Author's abstract)
W90-01717

**SUPERFUND RECORD OF DECISION: L.A. CLARKE AND SON, VA.**
Environmental Protection Agency, Washington, DC. Office of Emergency and Remedial Response.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-117402. Price codes: A04 in paper copy, A01 in microfiche. Report No. EPA/ROD/R03-88/040, March 1988. 76p, 6 fig, 4 tab.

Descriptors: *Water pollution sources, *Water pollution treatment, *Virginia, *Soil contamination, *Cleanup operations, Creosote, Benzene, Organic compounds, Hydrocarbons, Costs, Fate of pollutants, Biodegradation, Wood wastes.

The 40-acre L.A. Clarke site is located in Spotsylvania, VA. Wood preserving operations began at L.A. Clarke and Son, Inc. in June 1937 and have continued to date with only one inactive period, from April 1979 to June 1980. During the past 50 years, creosote contaminated soil and sediments resulted from facility operations spills, waste streams entering the drainage ditches, and onsite disposal. In 1975, L.A. Clarke and Son, Inc. was issued a National Pollution Discharge Elimination System (NPDES) permit for outfalls from two onsite drainage ditches. These permits are still in effect. Phenol is the only toxic contaminant regulated by the permit. In 1980, L.A. Clarke and Son, Inc. was classified under RCRA as a treater of hazardous waste due to the presence of wastewater impoundment lagoon. As part of a State-mandated remedial action in 1982, approximately 1,400 cu yd of soil was excavated from the processing area to create a RCRA-regulated soil waste pile. The primary contaminants of concern affecting both the soil and sediments (total volume of 119,000 cu yd) are constituents of creosote including polynuclear aromatics and benzene. The selected remedial action for this site includes: in-situ soil flushing of subsurface soil underlying the process buildings followed by in-situ biodegradation in the creosote layer area; biological degradation of bottom sediments in the lagoon; excavation, dredging, and onsite consolidation of contaminated sediments, subsurface wetland soil, buried pit materials, and surface soil not remediated via in-situ flushing; erosion/sedimentation control; backfilling excavated areas with treated soil and sediment; and groundwater monitoring. The estimated capital cost for this remedial action is $21,080,000 with present worth operation and maintenance of $33,900. Should be determined that the onsite process building requires removal, land farming/biodegradation may be implemented at an added capital cost of $910,000. (Author's abstract)
W90-01718

**EVOLUTION OF THE GROUNDWATER CHEMISTRY AROUND A NUCLEAR WASTE REPOSITORY.**
UKAEA Atomic Energy Research Establishment, Harwell (England). Theoretical Physics Div.
A. Haworth, S. M. Sharland, P. W. Tasker, and C.

J. Tweed.
Available from the National Technical Information Service, Springfield, VA 22161, as DE88-753613. Price codes: A03 in paper copy, A01 in microfiche. Report No. NSS-R.111, December 1987. 13p, 7 fig, 7 ref.

Descriptors: *Path of pollutants, *Water chemistry, *Waste disposal, *Model studies, *Geochemistry, Chemical reactions, Radioactive wastes, Groundwater movement, Geology, Clay, Hydrogen ion concentration.

Perturbations to the natural chemistry of the geology surrounding a nuclear waste repository may affect the overall nuclide release rates through properties such as their solubilities and sorption characteristics. In this paper, some of the necessary techniques to construct a research model of the evolution of the groundwater under the influence of the backfill material, are developed. These involve various extensions to the coupled ionic migration and chemical equilibria code, CHEQMATE. These extensions have been used in the first stages of a model of the chemical environment within the host rock. Although the design and location of a deep low- and intermediate-level nuclear waste repository have not yet been finalized in the U.K., in this preliminary model, the authors have considered a concrete backfill material embedded in a clay geology. However, the model is sufficiently flexible that other backfill materials and host rocks may be considered if a good thermodynamical description is available. The preliminary results from the model suggest that over timescales of about a thousand years, the natural buffering action of the clay against changes in pH has a significant effect on the scale of perturbation by the ingress of highly alkaline porewater. It seems likely, therefore, that this type of modeling will have considerable relevance to the safety assessment models. (Author's abstract)
W90-01722

**CLOSURE PLAN FOR THE DECOMMISSIONED HIGH EXPLOSIVES RINSE-WATER LAGOONS AT LAWRENCE LIVERMORE NATIONAL LABORATORY SITE 300.**
Lawrence Livermore National Lab., CA. Environmental Restoration Div.
D. W. Carpenter, A. L. Lamarre, N. B. Crow, and P. M. Swearengen.
Available from the National Technical Information Service, Springfield, VA 22161, as DE88-013161. Price codes: A06 in paper copy, A01 in microfiche. Report No. UCID--21369, May 31, 1988. 176p, 19 fig, 1 tab, 22 ref, 2 append.

Descriptors: *Waste disposal, *Water pollution treatment, *Cleanup operations, *Explosives, *Groundwater pollution, Lawrence Livermore National Laboratory, Geohydrology, Containment, Leaching, Permeability, Hydraulic conductivity, Capping.

Lawrence Livermore National Laboratory (LLNL) Site 300 is located in the Altamont Hills approximately 15 miles southeast of Livermore, CA. The High Explosives (HE) Process Area, one of the major facilities at Site 300, is located in the south central part of the site. Within the HE Process Area, nine relatively small, unlined lagoons formerly received rinse-water discharges from various process area buildings. The rinse waters were disposed of by evaporation and infiltration. Until 1980, these lagoons were operated under waste discharge requirements contained in Regional Water Quality Control Board (RQWCB) Order 78-148. At that time, the RWQCB rescinded the order and issued Order 80-183. The new order prohibited the discharge of industrial wastewater to unlined ponds or to the ground. To comply with that order, LLNL designed and constructed a surface impoundment system consisting of two doubly lined impoundments with a leachate collection system and a vadose zone and groundwater monitoring network. At their present locations, these compounds pose no direct threat to human health, safety, or the environment. The driving force that distributed the low levels of HE compounds and VOCs in the unsaturated zone was the hydraulic head generated by rinse water in the lagoons. With no further accumulation of liquids in the lagoons, the HE compounds and VOCs should remain immobile. To ensure this immobility, the authors propose to fill and cap the decommissioned lagoons with compacted backfill and clay soil. The compacted clay caps are specified to be a minimum of 2 ft thick and to extend beyond the edges of the lagoons. The clay caps will be constructed of materials selected, tested, and emplaced under the supervision of a qualified soils engineer. Imported backfill, compacted to 95% of its maximum density, will be placed beneath the clay caps. To reduce the potential for compromise of the compacted clay cap by bioturbation, the caps will be covered with 18 inches of uncompacted topsoil seeded with local grasses. (Lantz-PTT)
W90-01723

**DISSOLVED OXYGEN STRATEGIES FOR HYDRO RELICENSING.**
Oak Ridge National Lab., TN. Environmental Sciences Div.
S. F. Railsback.
Available from the National Technical Information Service, Springfield, VA 22161, as DE88-008373. Price codes: A03 in paper copy, A01 in microfiche. Report No. CONF-880498--1, (1988). 12p, 1 fig, 9 ref. DOE Contract DE-AC05-840R21400.

Descriptors: *Water pollution control, *Dissolved oxygen, *Water resources development, *Water quality control, Regulations, Reservoirs, Monitoring, Project planning, Management planning.

In licensing a new hydro project, or relicensing an existing project, the applicant must determine whether dissolved oxygen (DO) concentrations are an important issue. For proposed new developments, applicants should consider whether or not their project would cause DO problems, by considering whether they would create a stratified reservoir, or whether their project would eliminate an important existing source of aeration. Comparisons to similar existing projects can be made. At existing project, field data should show how much of a DO problem exists. State and federal regulatory and resources management agencies should be consulted to determine what DO concentrations they feel are required, and what the basis of this determination is (i.e. water quality standards, actual impacts on aquatic life, or antidegradation policies). A license applicant should define the scope and magnitude of the DO problem as accurately as possible, to reduce the uncertainty in the amount of mitigation required. Do concentrations should be monitored, measured, and modeled as necessary to determine under what conditions of season, flow, stratification, etc. a DO problem occurs, and to determine how severe this problem is. As much effort should be expended on developing appropriate and meaningful data analysis methods as on data collection. The collection of voluminous amounts of monitoring data that cannot or are not analyzed should be avoided. Predictive methods, such as statistical or mathematical models, should be developed as necessary to evaluate DO concentrations under various operating conditions. Once the range of DO concentrations (over space and time) resulting from the project has been determined, and the DO concentrations likely to be required by the permitting process have been determined, the need for mitigation can be determined. A thorough understanding of the processes that add and consume DO to the river is useful in finding the most cost-effective way to increase DO concentrations. (Lantz-PTT)
W90-01726

**CHEMICAL CHARACTERISTICS OF STREAMS IN THE MID-ATLANTIC AND SOUTHEASTERN UNITED STATES (NATIONAL STREAM SURVEY-PHASE I). VOLUME II: STREAMS SAMPLED, DESCRIPTIVE STATISTICS, AND COMPENDIUM OF PHYSICAL AND CHEMICAL DATA.**
Environmental Protection Agency, Washington, DC. Office of Acid Deposition, Environmental Monitoring, and Quality Assurance.
For primary bibliographic entry see Field 7B.
W90-01728

**ENVIRONMENTAL IMPACT ON OMBROTROPHIC BOGS IN NORTHWESTERN EUROPE: EFFECTS OF ACID RAIN AND NITROGEN POLLUTION ON RAISED BOGS AND BLANKET BOGS OF NORTHWEST EUROPE AND PRACTICAL MEANS OF CONSERVATION.**
Miljoestyrelsen, Roskilde (Denmark). Luftforureningslaboratoriet.
For primary bibliographic entry see Field 5C.
W90-01741

**EXPERIMENTS ON MODELS FOR AN OIL RETENTION AND COLLECTING DEVICE (MODELLVERSUCHE FUR EINE OEISPERRVORRICHTUNG UND OEISAMMEIVORRICHTUNG).**
K. Geistert.
Available from National Technical Information Service, Springfield, VA 22161 as TIB/B87-81374/GAR, Price codes: E09 in paper copy. Contract BMFT01 ZV 0908. Report 1049/85. 1985. 56p, 46 fig, 6 tab, 5 ref, append. In German.

Descriptors: *Oil spill cleanup, *Oil spills, *Cleanup operations, *Oil tankers, Equipment, Water pollution treatment.

Experiments were carried out on a model to investigate the resistance and performance at sea in transit and operationl states of a linked composite system consisting of a oil-collecting barge and two chains of floats to form a retaining barrier according to a Jebsen patent. The results make it possible to make statements about the suitability of the system for its intended purpose, and to draw comparisons with conventional devices and equipment. (Author's abstract)
W90-01743

**RESEARCH AND DEVELOPMENT IN WASTEWATER TECHNOLOGY AND IN PROTECTING WATER COURSES (FORSCHUNG UND ENTWICKLUNG IN DER ABWASSERTECHNIK UND BEIM GEWAESSERSCHUTZ-EINE STUDIE).**
Abwassertechnische Vereinigung e.V., St. Augustin (Germany, F.R.).
For primary bibliographic entry see Field 5D.
W90-01776

**INVESTIGATION OF THE MIGRATION OF HARMFUL ORGANIC SUBSTANCES THROUGH MINERAL SEALS BY MEANS OF RADIOACTIVE TRACERS (UNTERSUCHUNG DER MIGRATION VON ORGANISCHEN SCHADSTOFFEN DURCH MINERALISCHE DICHTUNGEN MITTELS RADIOAKTIVER TRACER).**
Ruhr Univ., Bochum (Germany, F.R.). Lehrstuhl fuer Grundbau und Bodenmechanik.
For primary bibliographic entry see Field 5B.
W90-01793

**DESIGN, CONSTRUCTION AND TESTING OF A PROTOTYPE FOR ABSORBING OIL CONTAMINATION IN THE SEA--PHASE 3: CONSTRUCTION AND TESTING (ENTWURF, BAU UND ERPROBUNG EINES PROTOTYPS ZUM ABSAUGEN VON OLVERSCHMUTZUNGEN IM MEER--PHASE III: BAU UND ERPROBUNG).**
Krupp (Fried.) G.m.b.H., Essen (Germany, F.R.). Forschungsinstitut.
G. Daut, P. Klein, U. Kolberg, C. J. Lorenzen, and W. Spandick.
Available from National Technical Information Service, Springfield, VA 22161 as DE88751695/GAR, Price codes: A07 in paper copy, A01 in microfiche. Report NP-8751695, 1984. 135p, 59 fig, 4 ref. In German.

Descriptors: *Oil pollution, *Oil spills, *Decontamination, *Cleanup, Oil suction device.

To fight the increasing contamination of the sea by oil, the Krupp Ruhr Wharf and the Krupp Research institute developed and built an oil suction

device for off-shore use. After manufacture of the equipment and acceptance of the electrical components, the equipment was transported to Cuxhaven for sea trials. The West German oil cleaning ship, the 'Scharhoern' was available for two days for the sea trials. The trials took place in a sea area north west of Heligoland. The trial indicated the equipment performed well. (Author's Abstract)
W90-01794

**STORMWATER MANAGEMENT ALTERNATIVES.**
Water Resources Center, University of Delaware, Newark, DE. April 1980. Edited by J. Toby Tourbier and Richard Westmacott. 351p.

Descriptors: *Water pollution control, *Storm water management, *Urban hydrology, *Conferences, *Storm runoff, *Storm water, *Storm sewers, *Storm wastewater, *Urban runoff, *Urban planning, Flood control, Water law, Water pollution, Nonpoint pollution sources.

Stormwater management remains a national problem. Flood losses are increasing in spite of ever-rising expenditures for flood control. Non-point sources of stormwater pollution from urban areas are the major source of water pollution in many areas. Most urban streams are neglected and often a sensual blight, even though more money has been spent (since 1972) to clean up the nation's waters than to construct the nation's highway network. Opportunities for multi-use planning are often ignored. Blue-green technology can incorporate flood control, stormwater pollution abatement, recreation, and comprehensive city planning and development. Stormwater management technology can be convivial (implying conviviere--with life) resulting in a product that can be lasting, functional and beautiful. This conference on Stormwater Management Alternatives was held in October 1979 in Wilmington, Delaware. It was initiated because of a contract with the Office of Water Research and Technology of the U.S. Department of the Interior, under which the editors investigated water resources protection technology and produced a handbook of measures to protect water resources in land development. In the current book which includes conference papers, topics are grouped under: I. A rationale for innovative and alternative stormwater management; II. Planning, construction and operation of systems; III. Case examples of successful programs; and IV. Institutional aspects of implementation. (See W90-01920 thru W90-01943) (Mertz-PTT)
W90-01919

**CONVIVIAL STORMWATER MANAGEMENT ALTERNATIVES.**
Delaware Univ., Newark. Water Resources Center.
J. T. Tourbier, R. Westmacott, and C. Goedken.
IN: Stormwater Management Alternatives. Water Resources Center, University of Delaware, Newark, DE. April 1980. p 9-21. 11 fig, 14 ref.

Descriptors: *Water pollution control, *Storm water management, *Urban hydrology, *Storm runoff, *Urban planning, *Flood control, *Storm wastewater, Water pollution, Nonpoint pollution sources, Erosion, Blue-green technology.

Stormwater and flood management and their interrelationship to water quality are problems of national priority. The costs of urban flooding and drainage works on a nationwide scale have been estimated to exceed $5 billion per year. There is opportunity for substantially reducing the cost of stormwater management by examining and, where appropriate, modifying conventional practices. Blue-Green stormwater technology turns a liability into an asset by integrating control measures in open space systems. This concept recognizes the potential of streams, rivers and other natural drainage ways as multi-use urban open space/water systems; and it realizes the potential asset of stormwater by transferring some of the costs of stormwater management to other beneficiaries. Four basic stormwater problems in urbanized areas that can be solved through design solutions which can result in enhancement of a site include: (1) Increases in runoff and decreases in infiltration; (2) Flooding and streambank erosion; (3) Erosion and sedimentation; and (4) Runoff pollution. Solving these problems requires public involvement in the planning process. Convergence of interests, legitimacy of sponsorship, establishment of an effectuation framework, leading to implementation of objectives are all necessary steps. (See also W90-01919) (Mertz-PTT)
W90-01920

**APPROPRIATE STORMWATER MANAGEMENT.**
Pennsylvania Univ., Philadelphia. Dept. of Landscape Architecture and Regional Planning.
I. L. McHarg.
IN: Stormwater Management Alternatives. Water Resources Center, University of Delaware, Newark, DE. April 1980. p 23-30.

Descriptors: *Water pollution control, *Storm water management, *Urban hydrology, *Storm wastewater, *Storm runoff, *Urban planning.

Wastewater management must be considered as an aspect of ecological planning. Planning is defined as the formulation of alternative futures, and then the recognition that these alternative futures require actions and courses of action. It is necessary to transmute every single one of these contemplated actions or courses of action, which can immediately address stormwater management, into costs and benefits. The important thing to recognize for all planners is that all values cannot be attributed; values can only be elicited. Planners must ask people what their values are. Planners must understand the biophysical and cultural aspects which enter into the system they are trying to create. Stormwater management requires ecological study, the development of ecological ordinances and the production of an ecologically-based plan. Another concept which must be explored is clearance-coverage ratios. This allows natural drainage via swales, detention basins and sediments basins. (See also W90-01919) (Mertz-PTT)
W90-01921

**LEGAL TOOLS FOR THE IMPLEMENTATION OF GREENWAY AND BLUE-GREEN TECHNOLOGY.**
Pennsylvania Univ., Philadelphia. Dept. of City and Regional Planning.
For primary bibliographic entry see Field 6E.
W90-01922

**BLUE-GREEN CONCEPT--SOME PERSONAL COMMENTS.**
Delaware Univ., Newark. Water Resources Center.
R. Westmacott.
IN: Stormwater Management Alternatives. Water Resources Center, University of Delaware, Newark, DE. April 1980. p 37-41. 7 fig.

Descriptors: *Water pollution control, *Storm water management, *Urban hydrology, *Storm wastewater, *Storm runoff, *Urban planning, Blue-green technology, Detention reservoirs.

The Blue-Green Concept is a deceptively simple one. Few examples of this idea exist, but those that have been implemented have been extraordinarily successful. Earl Jones first coined the term Blue-Green Development in the 1960s. When the term Blue-Green was first used, it referred to the planned integration of water areas in open space systems, multifunctional impoundments for both the detention of runoff and for aesthetic benefits. From its conception, storage and detention of urban stormwater were important features of Blue-Green development. The concept recognizes the multifunctional role of natural drainage systems. Failure to recognize these numerous roles of streams and rivers on urban development is probably the reason for little use of the Blue-Green concept. (See also W90-01919) (Mertz-PTT)
W90-01923

**INVESTIGATION OF CONCRETE GRID PAVEMENTS.**
Virginia Polytechnic Inst. and State Univ., Blacksburg. Coll. of Architecture and Urban Studies.
For primary bibliographic entry see Field 8F.
W90-01924

**POROUS PAVING.**
For primary bibliographic entry see Field 8F.
W90-01925

**COOPERATION FOR RECREATION AND STREAMBANK RETENTION--THE TIOGA COUNTY EXPERIENCE.**
Tioga County Planning Board, Oswego, NY.
For primary bibliographic entry see Field 4D.
W90-01926

**BEST MANAGEMENT PRACTICES IN THE 1978 NEEDS SURVEY.**
CH2M Hill, Inc., Gainesville, FL.
J. E. Scholl, and R. L. Wycoff.
IN: Stormwater Management Alternatives. Water Resources Center, University of Delaware, Newark, DE. April 1980. p 73-93. 7 fig, 3 tab, 7 ref. USEPA Contract No. 68-013993.

Descriptors: *Water pollution control, *Storm water management, *Urban hydrology, *Environmental Protection Agency, Surveys, Cost analysis, Water treatment facilities, Storm-overflow sewers, Sewers, Storm runoff, Water pollution control, Needs survey.

The U.S. EPA was mandated to submit to Congress a biennial Needs Survey report, which estimated the cost of constructing publicly-owned treatment facilities to ensure fishable and swimmable waters in the United States by 1983. The 1978 EPA Needs Survey report estimated that the cost for controlling combined sewer overflow at $25.7 billion and the cost of controlling pollution from urban stormwater runoff at $61.7 billion, both in January 1978 dollars. These cost estimates were based in part on a site-specific receiving water impact analysis of 10 combined sewer sites and 5 separate stormsewered sites across the nation. Two relatively independent phases were conducted to develop information related to receiving water impacts from combined sewer overflow and urban stormwater runoff and information related to cost-effective combinations of control alternatives for these sources of pollution. Phase I utilized continuous hydrologic simulation of the total urban environment to estimate the required stormwater pollution removal to obtain beneficial receiving water uses, and Phase II entailed production theory and marginal cost analysis to identify a cost-effective combination of streetsweeping and combined sewerflushing in series with storage/treatment to obtain any desired level of stormwater pollution removal from combined or separately sewered watersheds. Phase II results can be readily adapted to site-specific cultural and social values when a decision must be made whether to spend public monies for increasing beneficial receiving water uses. The results of the economic analyses indicated that it was generally more cost-effective to employ a mix of control alternatives rather than a single technology. Furthermore, best management practices (ie., streetsweeping and combined sewer flushing were generally most useful when overall pollutant removal requirements were low, whereas storage/treatment systems were most useful when overall removal requirements were high. (See also W90-01919) (Author's abstract)
W90-01927

**ROLE OF AQUATIC BIOLOGICAL MONITORING IN DETERMINING BEST MANAGEMENT PRACTICE EFFECTIVENESS.**
North Carolina Dept. of Natural Resources and Community Development, Raleigh. Div. of Environmental Management.
A. Duda.
IN: Stormwater Management Alternatives. Water Resources Center, University of Delaware, Newark, DE. April 1980. p 95-108. 1 tab, 19 ref. EPA Statewide Wastewater Treatment Management Planning Grant P004198010.

Descriptors: *Water pollution control, *Storm water management, *Urban hydrology, *Bioindicators, *Monitoring, *Urban runoff, *Storm runoff, Storm wastewater, Wastewater pollution, Water quality.

The sources of pollution on the types of water quality problems that occur in urban waters are reviewed. Emphasis was placed on the functioning of aquatic biological communities in streams and rivers and how the maintenance of biological integrity was central to the proper assimilation of man's wastes. Biological monitoring was advocated as an essential tool for evaluating whether stormwater management alternatives or other pollutants abatement measures really improved water quality in urban waters. Pollution sources included: municipal, industrial, and commercial wastes routinely discharged to storm sewers and urban streams without treatment, point source discharges that did not meet their effluent limits, the illicit dumping of wastes, discharging of toxics that did not have specified permit limits, combined sewer overflows, and leaking or broken sanitary sewers. Monitoring of benthic macroinvertebrates provided the most accurate and reproducible information on the status of water quality. Aquatic communities served as natural integrators of water quality, while chemical surveys provided information only at the moment of sampling. (See also W90-01919) (Mertz-PTT)
W90-01928

**STRATEGICALLY LOCATING ON-SITE DETENTION DEVICES USING THE PENN STATE RUNOFF MODEL.**
Satterthwaite Associates, Inc., West Chester, PA.
D. F. Lakatos.
IN: Stormwater Management Alternatives. Water Resources Center, University of Delaware, Newark, DE. April 1980. p 109-120. 3 fig, 15 ref.

Descriptors: *Water pollution control, *Storm water management, *Urban hydrology, *Cost analysis, *Storm runoff, *Detention reservoirs, *Flood control, *Urban planning, Computer programs, Storm water.

Among the most intriguing problems in stormwater management as it is being envisioned at this time was the choice of strategic locations for on-site detention devices (e.g., retention ponds) with the goal of reducing the peak discharge at a flood-prone point in the drainage basin as space-efficiently and cost-effectively as possible. One very effective way of accomplishing this was with the use of a computer simulation model. Several stormwater runoff simulation models were available, ranging from the very simple Corps of Engineers STORM to the highly complex EPA SWMM model. An overall description of the capabilities of the Penn State Runoff Model is presented, and its applicability for state-of-the-art stormwater management is highlighted. The model requires considerably less computer time than the HEC-1/HEC-2 package, the EPA Stormwater Management Model, and in fact most other widely-used stormwater runoff simulation programs. This model is beginning to be applied and used by consulting engineering firms for various practical stormwater management and planning studies. Original verification of the computational routines in the model was performed using the data for the Winohocking Watershed in Philadelphia, and the Boneyard Creek Watershed in Illinois. The Penn State Runoff Model is an effective tool for analyzing cost-effective stormwater management systems for developed areas. The model was developed in response to a need for such a tool for use in evaluating the state-of-the-art techniques for stormwater runoff control. A thorough verification of the program was performed as part of its development, and it has been used for several practical stormwater management applications. (See also W90-01919) (Mertz-PTT)
W90-01929

**PLANNING FOR RIPARIAN ENVIRONMENTAL QUALITY OPTIONS IN A SMALL WATERSHED IN NEW JERSEY.**
Betz, Converse, Murdock, Inc., Plymouth Meeting, PA.
For primary bibliographic entry see Field 4D.
W90-01930

**NATURAL DRAINAGE IN THE WOODLANDS.**
Wallace, McHarg, Roberts and Todd, Philadelphia, PA.
For primary bibliographic entry see Field 4A.
W90-01931

**IMPLEMENTATION OF STORMWATER MANAGEMENT IN A CANADIAN MUNICIPALITY: THE MARKHAM EXPERIENCE WITH SITE TAILORED CRITERIA.**
Ottawa Univ. (Ontario). Dept. of Civil Engineering.
For primary bibliographic entry see Field 4A.
W90-01932

**PUBLIC VALUES AND A RIVER--THE BRANDYWINE STORY.**
Brandywine Conservancy, Chadds Ford, PA.
For primary bibliographic entry see Field 6F.
W90-01933

**DRAINAGE RECONSIDERED: THE EVOLVING ROLE OF PUBLIC AGENCIES IN DRAINAGE--NEW CASTLE COUNTY, DELAWARE.**
New Castle County Water Resources Agency, Newark, DE.
For primary bibliographic entry see Field 4A.
W90-01934

**AREAWIDE AND LOCAL FRAMEWORKS FOR URBAN NONPOINT POLLUTION MANAGEMENT IN NORTHERN VIRGINIA.**
Northern Virginia Planning District Commission, Annandale.
J. P. Hartigan, B. Douglas, D. J. Biggers, T. J. Wessel, and D. Stroh.
IN: Stormwater Management Alternatives. Water Resources Center, University of Delaware, Newark, DE. April 1980. p 211-245. 3 fig, 1 tab, 23 ref.

Descriptors: *Water pollution control, *Storm water management, *Urban hydrology, *Virginia, *Nonpoint pollution sources, *Water pollution control, *Environmental protection, *Regional development, Occoquan River Basin, Runoff.

Areawide and local programs were established to manage nonpoint pollution in the Occoquan River Basin, Virginia. The first section summarized the 208 planning studies that laid the groundwork for nonpoint pollution management programs in the basin. The second section outlined the framework of the areawide management program which was established by the basin's local governments and water resources management agencies and was administered by Northern Virginia's regional planning agency. The third section presented a case study of a local management program developed by Fairfax County persuant to the areawide management program and local water quality management objectives. (See also W90-01919) (Author's abstract)
W90-01935

**STREAM VALLEY AND FLOOD PLAIN MANAGEMENT IN MONTGOMERY COUNTY, MARYLAND.**
Maryland-National Capital Park and Planning Commission, Silver Spring.
For primary bibliographic entry see Field 4D.
W90-01936

**ACHIEVING LOCAL SUPPORT FOR SURFACE RUNOFF MANAGEMENT IN THE SAN FRANCISCO BAY AREA.**
Association of Bay Area Governments, Berkeley CA.
For primary bibliographic entry see Field 6B.
W90-01937

**ADDRESS BEFORE THE NATIONAL CONFERENCE ON STORMWATER MANAGEMENT ALTERNATIVES.**
Environmental Protection Agency, Philadelphia, PA. Region III.
J. J. Schramm.
IN: Stormwater Management Alternatives. Water Resources Center, University of Delaware, Newark, DE. April 1980. p 275-279.

Descriptors: *Water pollution control, *Storm water management, *Urban hydrology, *Water law, *Nonpoint pollution sources, *Legal aspects, *Clean Water Act, *Water pollution control, Environmental protection.

The Federal Water Pollution Control Act Amendments of 1972 gave our country, for the first time, effective legislation for controlling water pollution. The provisions of the act gave a good indication of the viewpoint many held at the time as to the solutions to our water pollution problems. Those provisions were overwhelmingly oriented towards point-source control. The keystones of the Clean Water Act were The Grants Program for Construction of Municipal Sewage Treatment Facilities under Section 201 and the National Pollutant Discharge Elimination System Permit Program under Section 402. Nonpoint sources were also considered of concern, but certainly not of equal importance. Control of these sources was left to the voluntary use of best management practices to be developed under Section 208 Water Quality Management Plans. Research done in part under Section 208 has shown clearly just how important nonpoint source pollution control was, and stormwater runoff, particularly in urbanzied areas, was found to be one of the most widespread and difficult of the nonpoint sources. The authors suggested that researchers and policy makers need to appeal to the average citizen by educating them about the problems and various solutions related to control of stormwater runoff. Stormwater could be made into a resource that can actually enhance their health, safety, and recreational activities. (See also W90-01919) (Mertz-PTT)
W90-01938

**LET'S SETTLE THE STORMWATER MANAGEMENT ISSUE.**
North Carolina Dept. of Natural Resources and Community Development, Raleigh.
N. S. Grigg.
IN: Stormwater Management Alternatives. Water Resources Center, University of Delaware, Newark, DE. April 1980. p 281-286.

Descriptors: *Water pollution control, *Storm water management, *Urban hydrology, *Runoff, *Storm runoff, *Urban planning, Nonpoint pollution sources, Sewers.

Beginning in the mid-1960s, the United States realized that urban runoff, both from separate and combined sewers, constituted a serious pollution source. Since that time, millions of dollars were spent on research and demonstration projects and a number of installations designed to halt combined sewer overflow were built. Meanwhile, local governments continued to manage development and billions of dollars of stormwater management facilities in the form of gutters, pipes, ponds, ditches and canals were built. Congress delayed decisions about nonpoint runoff control because they really did not know how to control the urban sources. In addition to the problem of low total research expenditures, another problem existed because too much effort was spent on the development of advanced tools and techniques which were a long way from the practical. Implementation of programs aimed at integrating better housekeeping into normal municipal practice were needed. Such measures as street sweeping, control of litter and dump sites, control over air pollutants, deliberate and wise use of detention storage and more attention to stormwater management programs at the local level should have received greater emphasis. As an example of effective presentation of the stormwater management problem the April 1979 Conference on Stormwater Management which

was held in North Carolina is mentioned. (See also W90-01919) (Mertz-PTT)
W90-01939

**SPECIAL DISTRICTS FOR THE MANAGEMENT OF ENVIRONMENTAL QUALITY.**
Delaware Univ., Newark. Coll. of Urban Affairs and Public Policy.
F. Tannian.
IN: Stormwater Management Alternatives. Water Resources Center, University of Delaware, Newark, DE. April 1980. p 309-315.

Descriptors: *Water pollution control, *Storm water management, *Urban hydrology, *Environmental policy, *Legal aspects, Boundaries, Special districts, Environmental protection.

Environmental management could be more efficiently carried out by Special Districts. Reliable ways to determine how Special Districts could provide environmental services more effectively should be created and legal procedures that would reduce the political resistance costs of forming Special Districts must be developed. Five distinct effects of forming a Special District should be considered. (1) The size of populations being served environmental services would be modified. (2) Negative externalities that had existed could be reduced and positive externalities which had not been realized by the previous structure might be increased. (3) Coalitions of preferences by corporate or household citizens in the Special District and in the older governmental units for environmental services might change. (4) The potential for technological innovations might be raised. (5) The unit costs of delivering environmental services might be changed. Special Districts are institutional innovations. Potentially, they would allow people to arrange themselves for improved joint consumption or production of certain services. (See also W90-01919) (Mertz-PTT)
W90-01941

# 6. WATER RESOURCES PLANNING

## 6A. Techniques Of Planning

**CLUSTER ANALYSIS AS APPLIED TO REGIONAL FLOOD FREQUENCY.**
Manitoba Univ., Winnipeg. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W90-01344

**WATER RESOURCES MANAGEMENT IN NORTH CHINA PLAIN.**
Humboldt State Univ., Arcata, CA. Dept. of Environmental Resources Engineering.
R. Willis, B. A. Finney, and D. Zhang.
Journal of Water Resources Planning and Management (ASCE) JWRMD5, Vol. 115, No. 5, p 598-615, September 1989. 9 fig, 2 tab, 20 ref, append.

Descriptors: *Water resources development, *Water costs, *Resources management, *Regional planning, *Surface-groundwater relations, *China, *Groundwater management, Crop production, Wheat, Corn, Cotton, Fertilizers, Drainage districts, River basins, Pumping, Agricultural watersheds, Crop yield, Hydraulic models, Finite element method, Optimization.

A conjunctive optimization groundwater-surface water planning model has been developed which maximizes the net revenue generated from the production of wheat, corn, and cotton over a one-year planning horizon. The costs of production include distribution costs for Yellow River water, fertilizer, and nonlinear groundwater pumping costs. The decision variables of the model are the groundwater pumping schedules and the allocation of surface water, fertilizer, and land to the four drainage basins of the study area. Agricultural production functions are developed for the Yucheng County region of the North China Plain. The production functions relate yield per hectare of wheat, corn, and cotton and the applied water and fertilizer. The groundwater hydraulic response equations are developed using the finite element method and the matrix exponential. The groundwater equations are imbedded as constraints in the planning model. Optimization results are presented for a range of hydrologic conditions. The results are compared with present allocation patterns in Yucheng County. (Author's abstract)
W90-01346

**CCGP MODEL FOR MULTIOBJECTIVE RESERVOIR SYSTEMS.**
Northern Kentucky Univ., Highland Heights. Dept. of Management and Marketing.
For primary bibliographic entry see Field 5F.
W90-01350

**IMPLEMENTATION STRATEGIES FOR SALINITY PROJECTS.**
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5G.
W90-01351

**NETWORK MODELS OF WATER RIGHTS AND SYSTEM OPERATIONS.**
WBLA, Inc., Boulder, CO.
For primary bibliographic entry see Field 6E.
W90-01352

**MULTICRITERION FOREST WATERSHED RESOURCES MANAGEMENT.**
Arizona Univ., Tucson. School of Renewable Natural Resources.
A. Tecle, M. Fogel, and L. Duckstein.
IN: Forest Hydrology and Watershed Management. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication No. 167, 1987. p 617-625, 5 fig, 20 ref.

Descriptors: *Forest watersheds, *Decision making, *Watershed management, *Arizona, Sensitivity analysis, Model studies, ELECTRE.

An Arizona case study consisting of six alternative schemes was evaluated with respect to 15 noncommensurable, discrete criteria, using two types of multicriterion decision-making (MCDM) techniques: the outranking types of ELECTRE I and II; and the distance-based type of compromise programming (CP). The result was a complete preference ordering of the nondominated alternatives in the cases of ELECTRE II and CP and a partial ranking in the case when ELECTRE I was used. To determine the ranking process, each technique requires a number of parameters the value of which are mostly determined by the decision maker. These parameters are generally model specific. Sensitivity analyses on the individual techniques indicate that the results of ELECTRE II and CP applications are fairly robust with respect to parameter changes while those of ELECTRE I were found to be highly sensitive to changes in the threshold levels. With regard to consistency, and complete ordering capacity, compromise programming seems to be a preferred technique followed by ELECTRE II. However, ELECTRE I is simpler to use than ELECTRE II. (See also W90-01432) (Author's abstract)
W90-01490

**HYDROLOGICAL PROCESSES AND WATER MANAGEMENT IN URBAN AREAS.**
For primary bibliographic entry see Field 2A.
W90-01612

**DETAILED WATER BUDGET FOR THE CITY OF LUND AS A BASIS FOR THE SIMULATION OF DIFFERENT FUTURE SCENARIOS.**
Lund Univ. (Sweden). Dept. of Water Resources Engineering.
J. Niemczynowicz.
IN: Hydrological Processes and Water Management in Urban Areas. Proceedings of the International Symposium 24-29 April 1988, Duisburg, West Germany. International Hydrological Programme of UNESCO Publication, 1988. p 85-94, 2 fig, 1 tab, 10 ref.

Descriptors: *Urban hydrology, *Water pollution, *Hydrologic budget, *Lund, *Simulation analysis, *Water management, Sweden, Storm water, Runoff, Paving.

The costs of water management in many European cities are growing rapidly. New policies with respect to wastewater and storm water management must be grounded in a thorough understanding of the interrelations between different parts of the urban water budget. An extensive project aimed at explaining the details of this water budget has been performed in the city of Lund, Sweden. Detailed knowledge about the natural and urban water cycle in Lund was gained as a result of the project, and has now been used to simulate the outcomes of different storm water management policies which can be applied in this city. Two examples of the impacts of different policies are given: (1) the hydrological, environment and economical effects of a complete separation of storm water and wastewater systems are described; and (2) permeable pavements are constructed in order to attenuate storm water runoff. The separation of waste and storm water systems in cities in Sweden is economically unacceptable and technically insufficient to prevent further degradation of water quality in receiving waters. The only real benefit of such a separation is the elimination of combined sewer overflows. However, the total pollution loads from the city would hardly be reduced. The risks of toxic effects on ecologic systems in rivers during heavy rainfalls could be increased. The porous pavement constructions have great potential when it comes to reducing and attenuating storm water runoff. It is highly tempting to use this construction on a larger scale. Still, many questions concerning the long-term environmental risks of groundwater pollution must be answered before it can be recommended. (See also W90-016012) (Lantz-PTT)
W90-01622

**PLANNING FOR WATER SUPPLY IN GROWING URBAN AREAS-A CASE EXAMPLE OF HAT YAI/SONGKHLA, THAILAND.**
Waterworks Authority, Bangkok (Thailand).
W. Ghooprasert.
IN: Hydrological Processes and Water Management in Urban Areas. Proceedings of the International Symposium 24-29 April 1988, Duisburg, West Germany. International Hydrological Programme of UNESCO Publication, 1988. p 133-141, 3 fig, 1 tab, 3 ref.

Descriptors: *Water resources development, *Water management, *Urban areas, *Thailand, *Water demand, Case studies, Urban hydrology, Water supply, Reservoirs, Groundwater budget.

Thailand is a fast growing country and has reached the middle-income level. During its Fifth National Plan (1981-1985), a number of 'regional growth centers' were designated by the government in order to stimulate the local economies and stop the influx of population into the capital, Bangkok. The Provincial Waterworks Authority (PWA), which is the agency responsible for water supply in large and small communities across the country, (except Bangkok) must lay out long-term plans that will accommodate an adequate water supply to urban and semi-urban areas within the region. Particular attention is paid to Hat Yai and Songkhla, the two biggest cities, which are the main commercial and administrative centers of the Lower South. It has been estimated that in the Hat Yai-Songkhla Water Supply region, the population in the service area will increase from 299,426 in 1986 to around 550,000 in 1210, representing an average growth rate of around 2.6%. The present water source, Klong U-Taphao, has proven to be insufficient for this region during the low-flow periods of dry years. In addition, detailed studies of the groundwater resources have shown that under the present level of abstraction (7,000 cu m/day) by private users in Hat Yai. Two dams located on the tributaries of the Klong U-Taphao may be used: (1) the

Klong La Dam located 25 km from Hat Yai with an active storage volume of about 20 million cu m; and (2) the planned Sadao Dam, located about 50 km south of Hat Yai, with an active storage volume of 21.3 million cu m. In accordance with the intended service areas, the distribution system will be divided into three main zones: the Hat Yai Zone, the Songkhla Zone and the Carridor Zone, each of which will be provided with its own storage located as close as possible to the supply area. Trunk mains ranging in size from 700 mm to 900 mm diameters will be laid to strengthen the present conveyance capacity, or to bring water to the new service reservoirs. (See also W90-01612)(Lantz-PTT)
W90-01627

**MANAGEMENT OF AVAILABLE WATER RESOURCES AS A BASIS FOR POLLUTION CONTROL AND RATIONAL USE.**
Niedersaechsisches Landesamt fuer Wasserwirtschaft, Hildesheim (Germany, F.R.).
For primary bibliographic entry see Field 5G.
W90-01631

**MODERNIZATION AND DEVELOPMENT OF SEWERAGE AND DRAINAGE SYSTEMS OF WARSAW AND CRACOW AGGLOMERATIONS.**
Institute of Environmental Protection, Warsaw (Poland).
For primary bibliographic entry see Field 5D.
W90-01634

**TOWARDS COMPLETE INTEGRATION OF WATER QUALITY ASPECTS IN URBAN WATER MANAGEMENT DESIGN.**
Witteveen and Bos, Deventer (Netherlands).
For primary bibliographic entry see Field 5D.
W90-01637

**TOWARDS A SPECIFIC APPROACH OF URBAN HYDROLOGY IN AFRICA.**
Montpellier-2 Univ. (France).
For primary bibliographic entry see Field 5G.
W90-01638

**APPROPRIATE TECHNOLOGY FOR URBAN DRAINAGE IN DEVELOPING COUNTRIES.**
Technische Univ. Muenchen (Germany, F.R.). Lehrstuhl fuer Wassergutewirtschaft und Gesundheitsingenieurwesen.
For primary bibliographic entry see Field 5G.
W90-01641

**MANAGERIAL ASPECTS OF THE DESIGN AND OPERATION OF MODERN URBAN SEWAGE SYSTEMS.**
Rotterdam Public Works Dept. (Netherlands).
For primary bibliographic entry see Field 5D.
W90-01642

**IRRATIONALITY IN DECISION MAKING PROCESS EXEMPLIFIED BY APPLIED POLICIES CONCERNING STORMWATER DETENTION IN DIFFERENT COUNTRIES.**
Lund Univ. (Sweden). Dept. of Water Resources Engineering.
J. Niemczynowicz.
IN: Hydrological Processes and Water Management in Urban Areas. Proceedings of the International Symposium 24-29 April 1988, Duisburg, West Germany. International Hydrological Programme of UNESCO Publication, 1988. p 311-315.

Descriptors: *Wastewater management, *Urban hydrology, *Storm water, *Decision making, *Water management, Comparison studies, Drainage systems, Urban areas, Sweden, Denmark, West Germany.

Different criteria for determining policies for storm water management problems may be found in different countries. The reasons for these differences are not always rational. Examples given in this paper prove that there are policies which are not entirely based on rational grounds and, therefore, should be revised and changed, especially if they might cause environmental and economic disasters. This thesis is exemplified by discussing differences in policies concerning storm water drainage and infiltration as they are applied in Sweden, Denmark, West Germany, and the United States. Irrational and ill-grounded practices, such as those found in water management, may be discovered and eliminated by comparisons with applied policies in different countries. (See also W90-01612) (Lantz-PTT)
W90-01646

**INTEGRATED METHODOLOGIES FOR THE CONTROL OF URBANIZATION EFFECTS ON GROUNDWATERS IN THE PALERMO AREA (SICILY).**
Palermo Univ. (Italy). Ist. di Geofisica Mineraria.
For primary bibliographic entry see Field 5G.
W90-01658

**PLANNING WATER MANAGEMENT FOR AN ANCIENT GREEK CITY.**
Rensselaer Polytechnic Inst., Troy, NY. School of Architecture.
D. P. Crouch.
IN: Hydrological Processes and Water Management in Urban Areas. Proceedings of the International Symposium 24-29 April 1988, Duisburg, West Germany. International Hydrological Programme of UNESCO Publication, 1988. p 639-647, 7 ref.

Descriptors: *Water resources development, *Greece, *Water management, *History, Costs, Water supply, Economic aspects.

Traditional knowledge on finding and collecting water, and increased sophistication in fresh and used water transport, characterized the water management of Corinth and Syracuse in the 7th to 1st centuries BC. Both survival and amenity were assured. Every potential water decision was evaluated as to its cost in human effort and wealth. Weighed in the cost-benefit analysis were reuse and extended use. The pressure pipe line (siphon) functioning in Syracuse by 450 BC may be associated with the increased wealth and population of Gelon's reign. Syracuse was a large, wealthy city where money was deliberately invested in the water system. Similarly, governmental money must have gone into the water system when it was decided to rebuild the city of Corinth and turn it over to Roman army veterans. These two cities provide examples of water in the urban landscape and water as the sine qua non of urban ecosystems. (See also W90-01612) (Lantz-PTT)
W90-01683

**CHALLENGES OF WATER SUPPLY DEVELOPMENT IN THE URBANISED ISLAND OF PENANG, MALAYSIA.**
Brunei Univ., Bandar Seri Begawan. Dept. of Geography.
For primary bibliographic entry see Field 3D.
W90-01685

**WATER RESOURCES MANAGEMENT IN REGIONS WITH ENVIRONMENTAL PROBLEMS.**
Dortmund Univ. (Germany, F.R.).
D. Schroder.
IN: Hydrological Processes and Water Management in Urban Areas. Proceedings of the International Symposium 24-29 April 1988, Duisburg, West Germany. International Hydrological Programme of UNESCO Publication, 1988. p 775-782, 7 ref.

Descriptors: *Water resources management, *Environmental protection, *Public policy, *Water pollution control, Management planning, Economic aspects, Urban planning, Environmental policy, Lippe River, West Germany.

According to recent environmental policy tendencies, water resources planning bodies are required to purposefully participate in environmental quality planning, particularly in densely populated regions with unsatisfactory environmental conditions. The available water management instruments can be used for this task only is some features are considered in a new light. Among the underlying principles are: (1) a broader concept of economic efficiency, (2) the structural integration of comprehensive planning objectives; and (3) the definition of regionally variable targets for environmental quality. Some ideas are given on the necessity and feasibility of this approach using as an example the Lippe River basin, a semi-rural region under mounting environmental pressure on the periphery of the Ruhr area conurbation. (See also W90-01612) (Author's abstract)
W90-01699

**STRATEGIES IN URBAN WATER DESIGN.**
Technische Hogeschool Delft (Netherlands). Dept. of Architecture and Urban Regional Planning.
S. P. Tjallingii.
IN: Hydrological Processes and Water Management in Urban Areas. Proceedings of the International Symposium 24-29 April 1988, Duisburg, West Germany. International Hydrological Programme of UNESCO Publication, 1988. p 791-798, 2 fig, 19 ref.

Descriptors: *Water supply, *Water pollution control, *Urban planning, *Urban hydrology, *Water management, Hydrologic models, Erosion.

Internal problems of water in the urban ecosystem are usually 'solved' by increasing inflow and outflow. Therefore, problems of depletion may rise at the supply side, and pollution and erosion may result at the discharge side. Landscape disturbance may occur on both sides. Water management in urban areas should, therefore, give priority to those sets of internal solutions that decrease both input and output of the system, integrating internal and external water management. The purpose of this paper is to scan some technical-, design-, and policy-implications of this priority statement. First, the basic, problem-oriented concept of the approach is introduced. Then a model is given of urban waterflows demonstrating the role of technical principles in the general strategy. (See also W90-01612) (Author's abstract)
W90-01701

**IRRIGATION SYSTEMS MANAGEMENT RELATED TO METEOROLOGICAL FACTORS AND WATER RESOURCES.**
Ceske Vysoke Uceni Technicke v Praze. Faculty of Civil Engineering.
For primary bibliographic entry see Field 3F.
W90-01829

**EXPERIENCES WITH INTEGRATED IRRIGATION SYSTEM OPTIMIZATION ANALYSIS.**
Toronto Univ. (Ontario). Dept. of Civil Engineering.
For primary bibliographic entry see Field 3F.
W90-01849

**APPROPRIATE STORMWATER MANAGEMENT.**
Pennsylvania Univ., Philadelphia. Dept. of Landscape Architecture and Regional Planning.
For primary bibliographic entry see Field 5G.
W90-01921

**LEGAL TOOLS FOR THE IMPLEMENTATION OF GREENWAY AND BLUE-GREEN TECHNOLOGY.**
Pennsylvania Univ., Philadelphia. Dept. of City and Regional Planning.
For primary bibliographic entry see Field 6E.
W90-01922

**BLUE-GREEN CONCEPT--SOME PERSONAL COMMENTS.**
Delaware Univ., Newark. Water Resources Center.
For primary bibliographic entry see Field 5G.

W90-01923

**IMPLEMENTATION OF STORMWATER MANAGEMENT IN A CANADIAN MUNICIPALITY: THE MARKHAM EXPERIENCE WITH SITE TAILORED CRITERIA.**
Ottawa Univ. (Ontario). Dept. of Civil Engineering.
For primary bibliographic entry see Field 4A.
W90-01932

## 6B. Evaluation Process

**DESIGN AND CONSTRUCT CONTRACTS IN THE WATER INDUSTRY: 2. THE WAY AHEAD--THE CONTRACTOR'S VIEWPOINT.**
Biwater Ames Crosta, Heywood (England).
S. H. Greenhalgh, B. J. Armstrong, and J. E. A. Kerslake.
Journal of the Institution of Water and Environmental Management, Vol. 3, No. 3, p 239-243, June 1989. 3 ref.

Descriptors: *Contracts, *Process control, *Project planning, Chemical engineering, Performance evaluation, Construction methods, England.

In recent years there has been a trend in the U.K. towards design and construct contracts, particularly for the larger water industry process plants. This type of contract can be differentiated from a performance-based specification with process guarantees. It is suggested that the latter does offer a way forward and outlines the benefits of this format especially when accompanied by suitable conditions of contract such as those published by the Institute of Chemical Engineers. Some readjustment of positions and education is required on the parts of both the contractor and his project engineer to make the contracts work. Given this, and a joint willingness to meet what is a common objective, they can provide for successful contracts. (See also W90-01089 and W90-01091) (Fish-PTT)
W90-01090

**DESIGN AND CONSTRUCT CONTRACTS IN THE WATER INDUSTRY: 3. THE WAY AHEAD--THE CONSULTANT'S VIEWPOINT.**
Balfours, London (England).
For primary bibliographic entry see Field 5D.
W90-01091

**WATER DISTRIBUTION SYSTEM DESIGN UNDER UNCERTAINTIES.**
Oklahoma State Univ., Stillwater. School of Civil Engineering.
For primary bibliographic entry see Field 5F.
W90-01348

**UNDERSTANDING THE RESPONSE TO ENVIRONMENTAL RISK INFORMATION.**
Illinois Univ. at Urbana-Champaign. Inst. for Environmental Studies.
J. Vining.
IN: Biohazards of Drinking Water Treatment, Lewis Publishers, p 21-33, 1989. 28 ref.

Descriptors: *Water treatment, *Risks, *Information exchange, *Communication, *Public health, *Social needs, *Social aspects, Public relations, Environmental policy, Water pollution, Public policy, Social values.

Generalizations are presented regarding people's responses to environmental risk information. Information about environmental hazards and risks is generally imprecise and inferential in nature. Emotional, social, or cultural context may influence the perception of risks and the selection of alternative actions. The psychological and sociological literature on risk is large and growing rapidly. Communicating risk is notoriously complex and difficult. It is important to allow the complexity of risk information to enter into the judgment process. While preserving this complexity, information should be provided in a format that people can understand and manage. Providing digestible information entails using examples that are relevant to the target audience's background and using a scale that is comprehensible or related to the audience's experience. It is probably best to be the first to make a balanced and comprehensible presentation of the risks people are asked to accept. If the problem is likely to be inflamed or sensationalized by others, it is important to express concern and interest before the story is reported elsewhere. Finally, it is important to recognize the influence of emotion and intuitive factors and individual differences in preferences and judgmental styles. (See also W90-01750) (Friedmann-PTT)
W90-01752

**ROLE OF AQUATIC BIOLOGICAL MONITORING IN DETERMINING BEST MANAGEMENT PRACTICE EFFECTIVENESS.**
North Carolina Dept. of Natural Resources and Community Development, Raleigh. Div. of Environmental Management.
For primary bibliographic entry see Field 5G.
W90-01928

**ACHIEVING LOCAL SUPPORT FOR SURFACE RUNOFF MANAGEMENT IN THE SAN FRANCISCO BAY AREA.**
Association of Bay Area Governments, Berkeley CA.
S. J. Goldman, P. Y. Chiu, and M. H. Dunten.
IN: Stormwater Management Alternatives. Water Resources Center, University of Delaware, Newark, DE. April 1980. p 255-272. 19 ref.

Descriptors: *Water pollution control, *Storm water management, *Urban hydrology, *California, *Runoff, *Regional development, *Planning, Association of Bay Area Governments, Environmental protection.

As a part of the initial areawide water quality (208) planning effort, the Association of Bay Area Governments developed a planning process for the preparation of a regional surface runoff management plan. The plan was adopted by the local governments in June, 1978, and was approved by the U.S. Environmental Protection Agency with conditions in February, 1979. Since the plan's adoption, more than 90 management agreements were secured by the Association of Bay Area Governments (including agreements from 73 of 84 cities and 8 out of 9 counties) to implement control measures in the regional plan. The unique approach to local participation was largely responsible for the receptivity of local agencies and was emulated by other 208 agencies. Since local agencies were actively involved in the data collection, problem identification and control measure development, an implementable plan was assured. Regional and local public participation programs included advisory committee meetings, briefing sessions, public presentations, roundtable discussions, workshops, extensive mailing of plan progress reports, and a series of formal public hearings. Through these various means, the public was kept informed on the key issues and encouraged to participate in the planning process. (See also W90-01919) (Mertz-PTT)
W90-01937

## 6C. Cost Allocation, Cost Sharing, Pricing/Repayment

**DROUGHT EPISODES MANAGEMENT: THE ROLE OF PRICE.**
Hawaii Univ. at Manoa, Honolulu. Water Resources Research Center.
For primary bibliographic entry see Field 6D.
W90-00963

**HEDONIC PRICE ANALYSIS OF THE EFFECT OF A FLOODPLAIN ON PROPERTY VALUES.**
Wisconsin Univ.-La Crosse.
W. A. Donnelly.
Water Resources Bulletin WARBAQ, Vol. 25, No. 3, p 581-586, June 1989. 3 tab, 28 ref.

Descriptors: *Pricing, *Flood plains, *Property value, Statistical analysis.

The effect of a floodplain location on the market value for property is controversial, with the conventional wisdom being that buyers are myopic. Previous parametric and nonparametric statistical tests have proven inconclusive in deciding the issue. Herein, a theoretical model, that of hedonic price indexes, is posited and tested, using housing sales characteristics data obtained from a Multi-List Service cooperative. This study suggests that home buyers do adjust the purchase price for houses within a floodplain, and this amounts to, on average just over 12%. The data are from a small midwestern town in which the last severe flooding occurred a decade ago. (Author's abstract)
W90-00973

**METERING TRIALS FOR WATER SUPPLY.**
For primary bibliographic entry see Field 5F.
W90-01084

**DESIGN AND CONSTRUCT CONTRACTS IN THE WATER INDUSTRY: 1. THE WAY AHEAD--THE CLIENT'S VIEWPOINT.**
Yorkshire Water Authority (England).
For primary bibliographic entry see Field 5F.
W90-01089

**WATER RESOURCES MANAGEMENT IN NORTH CHINA PLAIN.**
Humboldt State Univ., Arcata, CA. Dept. of Environmental Resources Engineering.
For primary bibliographic entry see Field 6A.
W90-01346

**KIAMBERE HYDROELECTRIC PROJECT, KENYA: PART 1. PLANNING AND ECONOMIC STUDIES.**
For primary bibliographic entry see Field 8C.
W90-01354

**KIAMBERE HYDROELECTRIC PROJECT, KENYA: PART 3. FINANCE AND CONSTRUCTION.**
For primary bibliographic entry see Field 8C.
W90-01356

**WATER SUPPLY FROM THE WESTERN GERMAN NAVIGATION CANALS.**
Wasserverband Westdeutsche Kanale, Essen (Germany, F.R.).
For primary bibliographic entry see Field 5F.
W90-01630

**WATER RENT AS AN ECONOMIC INSTRUMENT FOR THE PROTECTION AND IMPROVEMENT OF WATER QUALITY FOR THE BENEFIT OF THE DRINKING WATER SUPPLY OF TOWNS.**
Technische Hochschule Aachen (Germany, F.R.).
U. Brosse.
IN: Hydrological Processes and Water Management in Urban Areas. Proceedings of the International Symposium 24-29 April 1988, Duisburg, West Germany. International Hydrological Programme of UNESCO Publication, 1988. p 729-734, 1 ref.

Descriptors: *Water rent, *Water quality, *Water supply, *Drinking water, *Water rates, *Water pollution prevention, West Germany, Potable water, Economic aspects, Groundwater quality.

Due to the increasing deterioration of the quality of groundwater and surface water, many West German towns and communities are increasingly dependent on receiving their water from remote regions. This results in two problems: (1) regions with a surplus of water have to deliver their water to towns without being paid for it. Towns may use this water for their own economic growth and for their wealth; and (2) since water does not cause any economic advantages to the water providing

regions, there is no economic interest in protecting the water against pollution. The efficiency of governmental regulations could be improved essentially, if an economic interest in the protection of water resources exists. An economic incentive such as water rent, seems necessary to guarantee the quantitative and qualitative supply of drinking water to towns. This paper deals with the possible effects of a water rent on the provision of drinking water to towns, and the resulting economic, environmental and regional/urban effects. (See also W90-01612) (Author's abstract)
W90-01693

**IRRIGATION AND WATER ALLOCATION.**
For primary bibliographic entry see Field 3F.
W90-01828

**BEST MANAGEMENT PRACTICES IN THE 1978 NEEDS SURVEY.**
CH2M Hill, Inc., Gainesville, FL.
For primary bibliographic entry see Field 5G.
W90-01927

**STRATEGICALLY LOCATING ON-SITE DETENTION DEVICES USING THE PENN STATE RUNOFF MODEL.**
Satterthwaite Associates, Inc., West Chester, PA.
For primary bibliographic entry see Field 5G.
W90-01929

## 6D. Water Demand

**DROUGHT EPISODES MANAGEMENT: THE ROLE OF PRICE.**
Hawaii Univ. at Manoa, Honolulu. Water Resources Research Center.
J. E. T. Moncur.
Water Resources Bulletin WARBAQ, Vol. 25, No. 3, p 499-505, June 1989. 8 fig, 1 tab, 14 ref.

Descriptors: *Drought, *Water allocation, *Water costs, *Water scarcity, Pricing, Hawaii.

Municipal water utilities, when faced with drought conditions, typically impose a temporary water use restrictions program to achieve conservation goals. If water is sufficiently price-elastic, however, at least some of the problems associated with restrictions can be avoided by imposing a drought surcharge and allowing users to adjust voluntarily. This paper develops two sources of evidence on price elasticity in Honolulu, Hawaii, with the evidence suggesting that a drought surcharge will induce much of the desired conservation, especially when used with educational publicity. (Author's abstract)
W90-00963

**MUNICIPAL UTILIZATION OF WATER DEMAND MANAGEMENT THE ONTARIO EXPERIENCE.**
Guelph Univ. (Ontario). Dept. of Geography.
For primary bibliographic entry see Field 5F.
W90-00982

**URBAN WATER BALANCE IN THE RHENISH LIGNITE AREA.**
For primary bibliographic entry see Field 4C.
W90-01616

**PRINCIPLES OF URBAN HYDROLOGY.**
Gosudarstvennyi Gidrologicheskii Inst., Leningrad (USSR).
For primary bibliographic entry see Field 4A.
W90-01619

**PLANNING FOR WATER SUPPLY IN GROWING URBAN AREAS-A CASE EXAMPLE OF HAT YAI/SONGKHLA, THAILAND.**
Waterworks Authority, Bangkok (Thailand).
For primary bibliographic entry see Field 6A.
W90-01627

**SURFACE AND GROUND WATER USE IN THE URBAN AREA OF ZAGREB.**
For primary bibliographic entry see Field 5F.
W90-01633

**PLAN OF STUDY: CONODOGUINET CREEK AND YELLOW BREECHES CREEK WATERSHEDS, A WATER RESOURCE ASSESSMENT.**
Susquehanna River Basin Commission, Harrisburg, PA.
G. J. Lazorchick.
Susquehanna River Basin Commissions, Harrisburg, PA. Publication No. 125, July 1989. 21p, 4 fig, 5 tab, 6 ref.

Descriptors: *Pennsylvania, *Water demand, *Water resources development, Conodoguinet Creek, Yellow Breeches Creek, Water use, Management planning, Economic aspects, Water management, Water quality.

The Conodoguinet Creek and Yellow Breeches Creek Watersheds are located in an area of south-central Pennsylvania that is currently experiencing a high rate of residential and commercial growth. This growth has increased the demand on the water resources of the region. Consequently there is concern in the public and private sectors as to whether enough water is available to meet all demands without seriously degrading the quality of the water supplies. This regional study of the Conodoguinet Creek and Yellow Breeches Creek Watersheds is designed to evaluate the availability of water in both watersheds. Water availability will then be compared with the levels of demands that are currently being experienced as well as against the levels of demand expected through the year 2010. The principal produce of this study will be the development of a water resource management strategy for the watersheds derived from the evaluation of the interactions of water quality, water quality, instream and out-of-stream demands; and the economic, environmental, engineering and political feasibility of various management alternatives. This study will also consider public opinion, political considerations and constraints, and agency criteria as well as individual, industrial, commercial, and public water supply management ideas in the formulation of the final water resource management strategy. (Lantz-PTT)
W90-01706

**IRRIGATION SYSTEMS MANAGEMENT RELATED TO METEOROLOGICAL FACTORS AND WATER RESOURCES.**
Ceske Vysoke Uceni Technicke v Praze. Faculty of Civil Engineering.
For primary bibliographic entry see Field 3F.
W90-01829

**PREDICTING WATER DEMANDS FOR IRRIGATION.**
Akademiya Nauk SSSR, Moscow. Inst. Vodnykh Problem.
A. G. Kudinov, and V. B. Mestechkin.
IN: Irrigation and Water Allocation. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication no. 169, 1987. p 163-173. 7 fig.

Descriptors: *Irrigation requirements, *Irrigation efficiency, *Model studies, *Water demand, Precipitation, Air temperature, Soil moisture retention, Irrigation water, Meteorological data collection.

Irrigated farming is one of the highest water-consuming branches of the national economy. This creates considerable difficulties in water supply and necessitates reliable water demand prediction. Methodology and techniques of predicting water demands for irrigated farming have been developed. The problem of water demand prediction is multifold. Its solution requires the assessment of natural, agrotechnical, physiological, socio-economic, ecological and other factors. A systematic geographical approach is the basis for methods and techniques of predicting water demands. The main role of natural predictors during water demand forecasting, such as temperature, moisture and precipitation are illustrated. Correlation matrices were composed on the basis of ten-day values of water demand and meterological elements. Since irrigation fills up soil moisture deficit, the decrease in crop capacity in the regions where atmospheric precipitation fills up a considerable part of irrigation water deficit would be less than in other regions. A correlation was obtained between the coefficient of crop capacity variability on irrigated lands and total atmospheric precipitation. Similar dependencies were plotted for air temperature and air humidity deficit. A case study is presented which describes the results of predicting irrigation water demands for the European part of the USSR for the year 2000. (See also W90-01828) (Geiger-PTT)
W90-01843

**HIERARCHICAL METHOD FOR THE DESIGN OF WATER ALLOCATION AND WATER DISTRIBUTION NETWORKS BASED ON GRAPH-THEORY.**
Tel-Aviv Univ. (Israel). Faculty of Engineering.
For primary bibliographic entry see Field 3F.
W90-01847

## 6E. Water Law and Institutions

**RIVER BASIN MANAGEMENT AND PRIVATIZATION.**
For primary bibliographic entry see Field 4A.
W90-01087

**CONTROL OF POLLUTION ACT 1974, PART II REGISTERS--PROMOTING THE PUBLIC INTEREST (ABRIDGED).**
Hull Univ. (England). School of Law.
For primary bibliographic entry see Field 5G.
W90-01093

**TOWARDS A NEW EC-WATERPOLICY.**
For primary bibliographic entry see Field 5G.
W90-01106

**CONTROL OF POLLUTION OF INLAND WATERS--A NECESSARY IMPULSE FOR THE BRITISH APPROACH.**
For primary bibliographic entry see Field 5G.
W90-01107

**EFFECTIVE WETLANDS POLICY: STICKS OR CARROTS.**
Iowa State Univ., Ames. Dept. of Botany.
A. van der Valk.
Environmental Forum ENVFEN, Vol. 6, No. 1, p 21-26, 1989.

Descriptors: *Wetlands, *Environmental policy, *Farm management, National Wetlands Policy Forum, Food Security Act, Clean Water Act, North Dakota, Conservation Reserve Program, Agricultural Wetlands Reserve Program.

Despite a history of scattered and incongruent programs addressing agricultural wetlands, the recent proposals of the National Wetlands Policy Forum may provide the guidance that has been so sorely lacking. This Forum suggest that in order for future federal wetlands policy to have force against agricultural interests, it must provide economic incentives to preserve existing wetlands and to restore those that have been drained. The Conservation Reserve Program has produced unexpected benefits for wetlands. This program, with the help of the U.S. Fish and Wildlife Service, Soil Conservation Service, Ducks Unlimited and other state and county agencies, has encouraged farmers to voluntarily restore hundreds of prairie potholes in Iowa, the Dakotas, and Minnesota. The National Agricultural Wetlands Reserve Program has been proposed by the National Wetlands Policy Forum for the next farm bill. It would ensure the protection of lands in the Conservation Reserve Program even if there is an increase in crop prices. This program would make provisions of the Food Security Act more palatable to farmers by compensat-

ing them for leaving their wetlands alone. The preservation or restoration of certain wetlands may greatly reduce environmental impacts of agriculture. For example, by using wetlands to absorb agricultural runoff, contamination of surface and groundwater can be lessened. There is no point, however, in establishing a National Agricultural Wetlands Reserve Program if the land it covers will eventually be destroyed or become so contaminated by agricultural runoff that it will become a hazard for waterfowl or other animals. To avoid the latter, research is needed immediately to determine the sustainable loading rates of nitrate, sediment, and various pesticides, as well as the long-term effects of these contaminants in wetlands. (Mertz-PTT)
W90-01118

**ALDO LEOPOLD AND WESTERN WATER LAW: THINKING PERPENDICULAR TO THE PRIOR APPROPRIATION DOCTRINE.**
Colorado Univ. at Boulder. School of Law.
C. F. Wilkenson.
Land and Water Law Review LWLRDC, Vol. 24, No. 1, p 1-38, 1989. 167 ref.

Descriptors: *Water law, *Prior Appropriation Doctrine, Aldo Leopold, Environmental policy, Legal aspects.

For almost all of its history, water law and policy has been nearly monolithic throughout the American West. The classic prior appropriation doctrine's 'first in time, first in right' rule is widely known, but there were numerous premises, corollaries, and consequences to the basic formulation. There have been efforts on several fronts to begin thinking and acting perpendicular to the prior appropriation doctrine. Nevertheless, comprehensive statutory reform remains necessary before such efforts can be successful. Natural resource use decisions should be made within the context of an integrated watershed plan that evaluates the economic, ecological, and cultural effects of such decisions. The scope of analysis under the classic prior appropriation doctrine ignores many of the multiple interactive impacts of a given allocation of water on the whole watershed community. The barriers to change are not insurmountable. Aldo Leopold, the father of modern natural resources policy, placed great faith in the ability of human society to come to understand its place in the scheme of things and to act accordingly. (Mertz-PTT)
W90-01124

**WYOMING'S GROUNDWATER LAWS: QUANTITY AND QUALITY REGULATION.**
Holland and Hart, Cheyenne, WY.
L. J. Wolfe, and J. G. Hager.
Land and Water Law Review LWLRDC, Vol. 24, No. 1, p 40-84, 1989. 291 ref.

Descriptors: *Water law, *Groundwater management, *Wyoming, *Groundwater management, Regulations, Environmental policy, Water permits.

Lack of population pressures, a high plains and mountain topography, a boom and bust energy and commodity economy, and the relative abundance of surface water have combined to quell or at least defer major conflicts over groundwater use. A practical explanation is provided of how Wyoming's groundwater laws are administered, and looks at the problems and opportunities that groundwater regulation holds for Wyoming as it moves into the 21st century. Groundwater resources, Wyoming's groundwater law, the state's permit system, groundwater storage, regulation of interconnected waters, mine dewatering and control of groundwater depletion are discussed. Domestic groundwater use and land use regulations are also presented. The article concludes with the topic of groundwater quality. (Mertz-PTT)
W90-01125

**INDIAN RESERVED WATER RIGHTS: AN ARGUMENT FOR THE RIGHT TO EXPORT AND SELL.**
C. Lichtenfels.
Land and Water Law Review LWLRDC, Vol. 24, No. 1, p 131-151, 1989. 199 ref.

Descriptors: *Water law, *Indian water rights, *Water rights, Water policy.

Water is the life-line of the arid West. Its possession means political and economic power. One study estimates that Indian water rights, many of which are still unadjudicated, consist of about 45 million acre-feet per year or three times the annual flow of the Colorado River. As the demand for water begins to exceed supply, focus on Indian water rights becomes increasingly intense. An issue currently inciting divisive discussion is whether Indian water rights encompass the right to sell and export the water off-reservation. This article discusses reserved water rights, and cites a number of treaties between the federal and state governments and Indian tribes concerning water rights. A well-rounded and common sense interpretation of the purpose of the treaties demands that the type of allowable use of Indian water not be restricted. Water reserved for Indian use may be used for a myriad of useful activities, be it irrigation, commercial sale, or other beneficial use. Indians and non-Indians alike could benefit from the action of the free market on this valuable resource. (Mertz-PTT)
W90-01126

**ENVIRONMENTAL LAW--WILL JURISDICTION ATTACH IN CITIZEN SUITS AGAINST WHOLLY PAST PERMIT VIOLATORS UNDER SECTION 505 OF THE CLEAN WATER ACT, 33 U.S.C. SECTION 1365. GWALTNEY OF SMITHFIELD V. CHESAPEAKE BAY FOUNDATION, INC., 108 S. CT. 376 (1987).**
W. A. Wilcox.
Land and Water Law Review LWLRDC, Vol. 24, No. 1, p 153-163, 1989.

Descriptors: *Water law, *Water pollution prevention, *Industrial wastes, *Virginia, Pagan River, Environmental policy, Chesapeake Bay Foundation, Natural Resources Defense Council, Clean Water Act.

Between 1981 and 1984, Gwaltney of Smithfield admitted exceeding its permitted limits on various pollutants it allowed to flow into Virginia's Pagan River. During the period, Gwaltney violated its limits on chlorine 34 times, fecal coliform 31 times and total Kjeldahl nitrogen 87 times. An upgraded wastewater treatment system installed in October 1983 ended violations on May 15, 1984. The Chesapeake Bay Foundation and Natural Resources Defense Council sent notice in February 1984, to Gwaltney, the Administrator of the Environmental Protection Agency, and the Virginia State Water Control Board, indicating their intent to sue under section 505 of the Clean Water Act, the citizen suit provision. The Foundation filed suit in the Eastern District of Virginia as private attorneys general in June, 1984, after Gwaltney's last violation, seeking civil penalties. This article discusses the case. In conclusion: The Gwaltney majority's holding that citizen suits against past violators can be maintained when good faith allegations of continuing violations are proffered could have been a positive step in clarifying the 'in violation' language of the citizen suit provision of the Clean Water Act. The allegation requirement alone would have halted suits without abatement purposes while allowing good faith actions to go forward. But, in an effort to further clarify the section, the majority reached too far by stating that Section 505 was prospective in nature and that the cases could be dismissed as moot if polluters came into compliance. Ultimately, the decision, in its effort to reach clarity, will further cloud the controversy, and it could severely limit the deterrence of the citizen suit. (Mertz-PTT)
W90-01127

**GWALTNEY OF SMITHFIELD, LTD. V. CHESAPEAKE BAY FOUNDATION: ITS IMPLICATIONS FOR CITIZEN SUITS UNDER THE CLEAN WATER ACT.**
California Univ., Berkeley. School of Law.
D. L. Lee.
Ecology Law Quarterly ECLQAR, Vol. 16, No. 2, p 571-593, 1989. 159 ref.

Descriptors: *Water law, *Water pollution, *Legal aspects, Law enforcement, Chesapeake Bay Foundation, Clean Water Act.

In Gwaltney of Smithfield, Ltd. v. Chesapeake Bay Foundation the Supreme Court directly addressed the issue of whether a citizen may sue to recover penalties for past violations of the Clean Water Act. The Court held that while there is no federal jurisdiction for wholly past violations of the Act, a citizen-plaintiff may bring suit if the complaint alleges in good faith an ongoing violation at the time of filing. The decision leaves open issues whose resolution will determine the continued effectiveness of citizen suits. For example, the Supreme Court did not resolve what constitutes a good faith allegation of a violation, when a violation will be considered ongoing for purposes of citizen suits, or what the plaintiff must prove to succeed on the merits. The decision did not address the question of the time at which the risk of noncompliance will be judged, how great that risk must be, or the basis of the penalty in cases where some violations were cured prior to the initiation of the suit. This Note examines citizen suits before Gwaltney, sets forth the factual context of the case, and describes the lower court decisions. It also presents the Supreme Court's majority and minority opinions, and critiques the decision and discusses its possible implications for citizen suits in the future. (Author's abstract)
W90-01150

**GROUNDWATER QUALITY REGULATION: EXISTING GOVERNMENTAL AUTHORITY AND RECOMMENDED ROLES.**
Wisconsin Univ.-Madison. Dept. of Agricultural Economics.
For primary bibliographic entry see Field 5G.
W90-01173

**WATER QUALITY ANTIDEGRADATION: THE COLORADO EXPERIENCE.**
For primary bibliographic entry see Field 5G.
W90-01192

**ANOTHER PERSPECTIVE ON COLORADO'S NEW ANTIDEGRADATION RULE.**
For primary bibliographic entry see Field 5G.
W90-01193

**NEW CLEAN WATER ACT TOXICS CONTROL INITIATIVES.**
For primary bibliographic entry see Field 5G.
W90-01194

**SDWA STANDARD: A FRAMEWORK FOR GROUNDWATER CLEANUP.**
For primary bibliographic entry see Field 5G.
W90-01195

**ACID RAIN OVER THE UNITED STATES AND CANADA: THE D.C. CIRCUIT FAILS TO PROVIDE SHELTER UNDER SECTION 115 OF THE CLEAN AIR ACT WHILE STATE ACTION PROVIDES A TEMPORARY UMBRELLA.**
For primary bibliographic entry see Field 5G.
W90-01264

**ACID RAIN REGULATION: FEDERAL FAILURE AND STATE SUCCESS.**
Hamline Univ., St. Paul, MN.
For primary bibliographic entry see Field 5G.
W90-01275

**NETWORK MODELS OF WATER RIGHTS AND SYSTEM OPERATIONS.**
WBLA, Inc., Boulder, CO.
C. M. Brendecke, W. B. DeOreo, E. A. Payton, and L. T. Rozaklis.

Journal of Water Resources Planning and Management (ASCE) JWRMD5, Vol. 115, No. 5, p 684-696, September 1989. 3 fig, 1 tab, 9 ref.

Descriptors: *Water conveyance, *Water rights, *Computer models, *Colorado, *Model studies, *Resources management, *Network design, Algorithms, Diversion, Economic aspects, Water delivery, Operating policies, Water demand, Municipal water, Industrial water, Streamflow, Taxes, Hydroelectric power, Raw water, Treated water.

A raw water supply Master Plan has been prepared for the City of Boulder, Colorado. The city's portfolio of water rights includes decrees for native water Boulder Creek and shares in two large transbasin diversion projects. The supply system is operated to meet municipal and industrial demands, provide minimum streamflows for Boulder Creek, and generate revenues from hydroelectric turbines installed in raw water and treated water transmission lines. The Master Plan was developed with the use of three applications of the Central Resource Allocation Model, a microcomputer-based network-optimization tool, which uses the Out-of-Kilter Algorithm. The three applications addressed the yield of the city's native water rights, the yield of its transbasin diversion project holdings, and the economic operation of its water delivery system to meet future demands. The Master Plan recommends modifications to certain operating policies, enlargement of some delivery and treatment facilities, and sale or lease of one of the transbasin water sources. (Author's abstract) W90-01352

**LAW OF INTERNATIONAL WATERCOURSES: SOME RECENT DEVELOPMENTS AND UNANSWERED QUESTIONS.**
McGeorge School of Law, Sacramento, CA.
S. C. McCaffrey.
Denver Journal of International Law and Policy, Vol. 17, No. 3, p 505-526 Spring 1989.

Descriptors: *Water law, *International agreements, *International commissions, *International law, *International waters, United Nations, Environmental protection, Water pollution, Utilization.

A review of recent developments in relation to the International Law Commission of the United Nations (ILC) work on International Watercourses with an examination of some of the questions that have arisen is presented. The topics covered include: (1) an overview of the history of laws concerning the non-navigational uses of international watercourses; (2) equitable utilization and the obligation not to cause appreciable transfrontier harm; (3) obligations of notification, consultation and negotiation concerning planned measures; and (4) environmental protection and pollution. It is believed that a draft will be completed in the near future which may be modeled after the 1982 United Nations Convention on the Law of the Sea. Article 94 of this Convention measures the performance of a flag state by whether it conforms to 'generally accepted international regulations procedures and practices.' The recently revised Restatement of U.S. Foreign Relations Law generalizes this standard and applies it to a source state's obligation to take measures to prevent extraterritorial environmental harm. The obligation of the source state is one of conduct rather than one of result. The applicable international rules and standards do not hold a state responsible when it has taken the necessary and practicable measures. The true test of the effectiveness of the Commission draft will be whether states apply it in concrete cases. (White-Reimer-PTT)
W90-01361

**POLLUTION CONTROL LAWS AGAINST PUBLIC FACILITIES.**
For primary bibliographic entry see Field 5G.
W90-01372

**SUPERFUND RECORD OF DECISION: ZELLWOOD, FL.**
Environmental Protection Agency, Washington, DC. Office of Emergency and Remedial Response.
For primary bibliographic entry see Field 5G.
W90-01703

**LEGAL TOOLS FOR THE IMPLEMENTATION OF GREENWAY AND BLUE-GREEN TECHNOLOGY.**
Pennsylvania Univ., Philadelphia. Dept. of City and Regional Planning.
A. L. Strong.
IN: Stormwater Management Alternatives. Water Resources Center, University of Delaware, Newark, DE. April 1980. p 31-35.

Descriptors: *Water pollution control, *Storm water management, *Urban hydrology, *Storm wastewater, *Storm runoff, *Urban planning, *Water law, Legal aspects, Blue-green technology.

Stormwater management law is not a well defined area; such laws as there are vary considerably throughout the nation. Perhaps no aspect of stormwater management leaves as many unanswered questions as the legal aspect. There are a fair number of state enabling acts which pertain to stormwater management and there are many local ordinances, but there is little judicial precedent concerning either the state acts or the local ordinances. Existing governmental structures should be used for regulating runoff. For developing areas, the state should mandate either county or municipal stormwater management plans, and require these plans for watersheds, rather than for government boundary units. Innovative programs need to be followed. The courts should support programs which prove to be fair and reasonable. (See also W90-01919) (Mertz-PTT)
W90-01922

**DRAINAGE RECONSIDERED: THE EVOLVING ROLE OF PUBLIC AGENCIES IN DRAINAGE--NEW CASTLE COUNTY, DELAWARE.**
New Castle County Water Resources Agency, Newark, DE.
For primary bibliographic entry see Field 4A.
W90-01934

**ADDRESS BEFORE THE NATIONAL CONFERENCE ON STORMWATER MANAGEMENT ALTERNATIVES.**
Environmental Protection Agency, Philadelphia, PA. Region III.
For primary bibliographic entry see Field 5G.
W90-01938

**GREENWAY CONCEPT WITHIN THE HERITAGE CONSERVATION AND RECREATION SERVICE.**
Heritage Conservation and Recreation Service, Philadelphia, PA.
For primary bibliographic entry see Field 4A.
W90-01940

**SPECIAL DISTRICTS FOR THE MANAGEMENT OF ENVIRONMENTAL QUALITY.**
Delaware Univ., Newark. Coll. of Urban Affairs and Public Policy.
For primary bibliographic entry see Field 5G.
W90-01941

**UNCOUNTED COSTS OF UNCONTROLLED WATER.**
Chester County Conservation District, West Chester, PA.
M. Haws.
IN: Stormwater Management Alternatives. Water Resources Center, University of Delaware, Newark, DE. April 1980. p 317-323. 13 ref.

Descriptors: *Water pollution control, *Storm water management, *Urban hydrology, *Legal aspects, *Overland flow, Water law, Streamflow.

Damages and restitution are awarded to a person when his physical body is damaged. Since property is the extension of a person's life and actions, it makes sense to provide justice to a person whenever his property is damaged and he is prevented from using it. It also seems reasonable that a property owner should be paid damages or restitution for problems caused by increased flow of water from an upstream property as a result of the actions of the owner of the upstream property or his agents. Arbitration could be used as a system to provide justice for the owner of the damaged property. The implementation of an arbitration program should take place at the lowest level of government (i.e., township, municipality or county). (See also W90-01919) (Mertz-PTT)
W90-01942

**PUBLIC PARTICIPATION IN ANNE ARUNDEL COUNTY'S WATER SHED MANAGEMENT PROGRAM.**
Anne Arundel County Office of Planning and Zoning, Annapolis, MD.
For primary bibliographic entry see Field 4D.
W90-01943

## 6F. Nonstructural Alternatives

**HEDONIC PRICE ANALYSIS OF THE EFFECT OF A FLOODPLAIN ON PROPERTY VALUES.**
Wisconsin Univ.-La Crosse.
For primary bibliographic entry see Field 6C.
W90-00973

**COMPREHENSIVE FLOOD DISASTER PREVENTION MEASURES IN JAPAN.**
Public Works Research Inst., Tsukuba (Japan).
T. Suetsugi.
IN: Hydrological Processes and Water Management in Urban Areas. Proceedings of the International Symposium 24-29 April 1988, Duisburg, West Germany. International Hydrological Programme of UNESCO Publication, 1988. p 391-398, 6 fig, 2 tab.

Descriptors: *Flood plain management, *Japan, *Flood control, *Urban hydrology, Flood damage, Maps.

In the course of the rapid economic growth of the 1960's, the concentration of population and residences in urban areas of Japan, especially in three major cities, increased rapidly. Subsequent land development in and around these areas had a major influence on the hydrologic cycle, and created the need for measures to combat flood disasters. When flood damage occurs, flood fighting, and refuge and relief activities are carried out as countermeasures against the flood. Specific countermeasures include: (1) the rapid collection and transmission of flood (damage) information; (2) investigation of the standard of refuge activity based on the total rainfall amount as well as warning water levels; and (3) the compilation and publication of a flood hazard map. (See also W90-01612) (Lantz-PTT)
W90-01656

**CONVIVIAL STORMWATER MANAGEMENT ALTERNATIVES.**
Delaware Univ., Newark. Water Resources Center.
For primary bibliographic entry see Field 5G.
W90-01920

**PUBLIC VALUES AND A RIVER--THE BRANDYWINE STORY.**
Brandywine Conservancy, Chadds Ford, PA.
W. Sellers.
IN: Stormwater Management Alternatives. Water Resources Center, University of Delaware, Newark, DE. April 1980. p 175-183.

Descriptors: *Water pollution control, *Storm water management, *Urban hydrology, *Community development, *Pennsylvania, *Environmental protection, Brandywine Conservancy, Community activism.

The Brandywine Conservancy, Chadds Ford, PA was founded in 1967 when it became apparent that land development was posing a new threat to the

Brandywine Valley. Community action by aroused residents and volunteer staff won many battles in the late 60s and early 70s. Powerline projects were modified, three devastating highway proposals were eliminated, plans for a new international airport abandoned, and the industrial development of the Chadds Ford floodplain was preempted by acquisition. Recognizing the importance of private land use decision-making, a Wilmington land use lawyer and member of the Conservancy agreed to assist in the development of a conservation easement program which would allow private landowners to voluntarily restrict the development and modifications of those areas of their property which heavily impact water resources: the flood plains, steep slopes, groundwater recharge areas, wetlands, et. al. The conservation easement used in conjunction with a facade easement also had been an important tool in insuring the long-term integrity of historic sites. Between 1969-1979 conservation easements over 4000 acres were donated to the Conservancy by landowners in the area. (See also W90-01919) (Mertz-PTT)
W90-01933

**STREAM VALLEY AND FLOOD PLAIN MANAGEMENT IN MONTGOMERY COUNTY, MARYLAND.**
Maryland-National Capital Park and Planning Commission, Silver Spring.
For primary bibliographic entry see Field 4D.
W90-01936

## 6G. Ecologic Impact Of Water Development

**BUILDING A BETTER WETLAND.**
Rivertech, Inc., Laguna Hills, CA.
For primary bibliographic entry see Field 5G.
W90-01265

**GEOMORPHIC AND VEGETATIVE RECOVERY PROCESSES ALONG MODIFIED TENNESSEE STREAMS: AN INTERDISCIPLINARY APPROACH TO DISTRIBUTED FLUVIAL SYSTEMS.**
Geological Survey, Nashville, TN.
A. Simon, and C. R. Hupp.
IN: Forest Hydrology and Watershed Management. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication No. 167, 1987. p 251-262, 6 fig, 1 tab, 15 ref.

Descriptors: *Geomorphology, *Stream improvement, *Flood control, *Channel erosion, *Tennessee, Channel morphology, Model studies.

The sand-bed stream channels of the Obion-Forked Deer River basin periodically have been dredged and straightened since the turn of the century to reduce flood magnitude and frequency. Channel bed, banks and flood plains are systematically adjusting their form and vegetative patterns over time and space in response to the latest episode of major channel modifications (1959-1973). Headward-progressing degradation heightens and steepens the loess-derived banks and causes channel widening (up to 1-4 m/yr) by mass-wasting processes. With time, aggradation reduces bank heights and continued mass failures reduce bank angles causing low-bank surfaces to stabilize and become revegetated. Riparian species characterize various stages of channel adjustment and are associated with specific geomorphic processes. Through ordination techniques, a predescribed six-stage model of channel evolution is supported by species presence data. (See also W90-01432) (Author's abstract)
W90-01456

**STORAGE RESERVOIRS FOR WATER SUPPLY OF ECOLOGICAL IMPORTANCE.**
Gelsenwasser A.G., Gelsenkirchen (Germany, F.R.).
For primary bibliographic entry see Field 5F.
W90-01632

**INFLUENCE OF URBANIZATION ON THE QUALITY OF GROUNDWATER.**
Slovenska Vysoka Skola Technicka, Bratislava (Czechoslovakia).
For primary bibliographic entry see Field 4C.
W90-01663

**DISSOLVED OXYGEN STRATEGIES FOR HYDRO RELICENSING.**
Oak Ridge National Lab., TN. Environmental Sciences Div.
For primary bibliographic entry see Field 5G.
W90-01726

# 7. RESOURCES DATA

## 7A. Network Design

**EFFECT OF SERIAL CORRECTION ON GROUNDWATER QUALITY SAMPLING FREQUENCY.**
Department of Scientific and Industrial Research, Christchurch (New Zealand). Geophysics Div.
M. E. Close.
Water Resources Bulletin WARBAQ, Vol. 25, No. 3, p 507-515, June 1989. 5 fig, 2 tab, 13 ref.

Descriptors: *Network design, *Water quality, *Water pollution sources, *Groundwater quality, *Sampling, *Uncertainty, Groundwater pollution, Nitrates.

Methods of calculating uncertainty in estimates of serial correlation coefficients, and correcting for bias in short and medium length (less than 50 data point) records, are presented. Uncertainty and bias in the estimation of serial correlation coefficient for groundwater quality data is shown to be considerably and to result in inaccurate calculation of the sampling frequencies for monitoring purposes. The methods are applied to a groundwater data set consisting of 87 monthly measurements of nitrate concentrations. The variation in serial correlation coefficients with variation of record length is examined. The optimum sampling frequencies for detection of changes in groundwater nitrate concentrations are estimated. (Author's abstract)
W90-00964

**HYDROLOGIC UNCERTAINTY MEASURE AND NETWORK DESIGN.**
University of Petroleum and Minerals, Dhahran (Saudi Arabia). Water Resources and Environment Div.
T. Husain.
Water Resources Bulletin WARBAQ, Vol. 25, No. 3, p 527-534, June 1989. 6 fig, 5 tab, 17 ref.

Descriptors: *Stream gages, *Data acquisition, *Network design, *Uncertainty, *Hydrologic data, Entropy, Rainfall-runoff relationships, Rain gages.

A simple methodology, using the entropy concept, to estimate regional hydrologic uncertainty and information at both gaged and ungaged grids in a basin is presented. The methodology described in the paper is applicable for (1) the selection of the optimum station from a dense network, using maximization of information transmission criteria, and (2) expansion of a network using data from an existing sparse network by means of the information interpolation concept and identification of the zones from minimum hydrologic information. The computation of single and joint entropy terms used in the above two cases depends upon single and multivariable probability density functions. In the paper, these terms are derived for the gamma distribution. The derived formulation for optimum hydrologic network design was tested using the data from a network of 29 rain gages on Sleeper River Experimental Watershed. For the purpose of network reduction, the watersheds was divided into three subregions, and the optimum stations and their locations in each subregion were identified. To apply the network expansion methodology, only the network consisting of 3 stations was used, and feasible triangular elements were formed by joining the stations. Hydrologic information was calculated at various points on the line segments, and critical information zones were identified by plotting information contours. The entropy concept used in this paper, although derived for single and bivariate gamma distribution, is general in type and can easily be modified for other distributions by a simple variable transformation criterion. (Author's abstract)
W90-00966

**COMBINATION OF RADAR AND GAUGE DATA IN A RAINFALL ARCHIVE SYSTEM.**
M. F. Mylne.
Water Resources Bulletin WARBAQ, Vol. 25, No. 3, p 535-539, June 1989. 2 fig, 9 ref.

Descriptors: *Network design, *Rainfall, *Meteorological data collection, *Radar, *Rain gages, United Kingdom.

Near real time rainfall estimates for the UK are available from three sources: a sparse network of gauges, radar data, or radar data adjusted by the sparse gauges. The PARAGON rainfall archive system, which has been developed by the UK Meteorological Office, is able to produce these estimates in near real time on a 5 km grid. The ability of these estimates to reproduce the 5 km grid point field derived later from a dense network of gauges is compared using case studies. Five techniques have been used to assess the relative quality of the various estimates. There is general agreement between the results of the various techniques. For the London radar there are examples of days when the rainfall estimate was improved by incorporating radar data; conversely, there are days when the radar data make it worse. Overall little evidence was found to suggest that adjusted radar data are consistently markedly better than gauge estimates. Discriminate use of radar data is recommended. (Author's abstract)
W90-00967

**DEFINING REGIONAL POPULATIONS OF LAKES FOR THE ASSESSMENT OF SURFACE WATER QUALITY.**
NSI Technology Services Corp., Corvallis, OR.
For primary bibliographic entry see Field 2H.
W90-00971

**KALMAN FILTER CALCULATIONS OF SAMPLING FREQUENCY WHEN DETERMINING ANNUAL MEAN SOLUTE CONCENTRATIONS.**
Colorado State Univ., Fort Collins. Dept. of Earth Resources.
J. D. Stednick, and L. C. Roig.
Water Resources Bulletin WARBAQ, Vol. 25, No. 3, p 675-683, June 1989. 3 tab, 26 ref.

Descriptors: *Statistical methods, *Network design, *Water quality, *Sampling, *Monitoring, *Solutes, *Kalman filter.

A linear filter (Kalman filter) technique was used with a streamflow concentration model to minimize surface water quality sampling frequencies when determining annual mean solute concentrations with a predetermined allowable error. The Kalman filter technique used the stream discharge interval as a replacement for the more commonly used time interval. Using filter computations, the measurement error variance was minimized within the sample size constraints. The Kalman filter application proposed here is applicable only under several conditions including: monitoring is solely to estimate annual mean concentration; discharge measurements errors are negligible; the streamflow-concentration model is valid; and monthly samples reflect the total variance of the solute in question. (Author's abstract)
W90-00983

**OXYGEN UPTAKE RATE APPROACH FOR ANALYSING RESPIROMETRIC BIOCHEMICAL OXYGEN DEMAND DATA: II. APPLICATION AND EVALUATION.**
McGill Univ., Montreal (Quebec). Dept. of Civil Engineering.

M. D. Cailas, and R. Gehr.
Water Research WATRAG, Vol. 23, No. 8, p 993-1001, August 1989. 4 fig, 8 tab, 25 ref.

Descriptors: *Instrumentation, *Water analysis, *Biochemical oxygen demand, *Data processing, *Model studies, Oxygen uptake rate, Cumulative data.

The oxygen uptake rate approach (OUR) is applied to a number of BOD data cases. The OUR is the difference between two consecutive cumulative observations divided by the time interval. The results indicate that by using the OUR form of data in combination with generated OUR-BOD models the resulting error structures are improved, in terms of independence. Furthermore, the duration of experiments for estimating BOD parameters with adequate precision is considerably less compared to that for obtaining similar parameters in the case of cumulative data. After considering both 1st and 2nd-order models, the 1st-order OUR model was found to be the most reliable one, in terms of precision, for estimating the rate constant and the ultimate BOD. The reliability of the 1st-order OUR model was further substantiated by assessment of its deviation from linearity, using curvature measures. (See also W90-00997) (Author's abstract)
W90-00998

**HIGH-RESOLUTION PROFILES OF TEMPERATURE AND DISSOLVED OXYGEN IN A RIVER.**
Queensland Univ., Brisbane (Australia). Dept. of Physics.
For primary bibliographic entry see Field 7C.
W90-01152

**CORRELATED VERSUS UNCORRELATED HYDROLOGIC SAMPLES.**
California Univ., Santa Barbara. Dept. of Geography.
H. A. Loaiciga, and P. F. Hudak.
Journal of Water Resources Planning and Management (ASCE) JWRMD5, Vol. 115, No. 5, p 699-705, September 1989. 2 fig, 1 tab, 6 ref.

Descriptors: *Statistical analysis, *Data interpretation, *Spatial distribution, *Correlation analysis, Sampling, Mathematical models, Data collections.

The application of statistical analysis to spatial data collection and experimental design is an area of growing interest to engineers and earth scientists. When dealing with spatial data, it is important to consider the possibility of spatial correlation and its effects on statistical inferences about the mean. One interesting result of such consideration is the relationship between the optimal sample sizes needed to estimate the population mean of a spatial variable under the independent and the correlated assumptions. The effect of spatial correlation on statistical inference and optimal sample size for population-mean determination is addressed. The relationship is useful in experimental design of data collection of spatial data. It is indicated that ignoring spatial correlation would lead to the use of a smaller sample size than that actually required to achieve a specified level of accuracy, thus leading to err on the unsafe side. On the other hand, if the correlation length scale of a spatial variable is known, one could design a sampling scheme that would yield an independently and identically distributed sample and thus introduce a substantial simplification in statistical inference about the mean. A simplification in terms of the 'average' correlation can be made. (Author's abstract)
W90-01353

**EFFECTS OF HYDROCHEMISTRY VARIABILITY ON WATER QUALITY SAMPLING FREQUENCIES IN AN ALPINE-SUBALPINE FOREST BASIN.**
Colorado State Univ., Fort Collins. Dept. of Earth Resources.
For primary bibliographic entry see Field 2K.
W90-01469

**CONCERNING THE EXPERIMENTAL MEASUREMENTS OF INFILTRATION FOR THE RUNOFF MODELISATION OF THE URBAN WATERSHEDS IN WESTERN AFRICA.**
Office de la Recherche Scientifique et Technique Outre-Mer, Montpellier (France).
C. Bouvier.
IN: Hydrological Processes and Water Management in Urban Areas. Proceedings of the International Symposium 24-29 April 1988, Duisburg, West Germany. International Hydrological Programme of UNESCO Publication, 1988. p 29-36, 5 fig, 2 tab, 8 ref.

Descriptors: *Urban hydrology, *Rainfall-runoff relationships, *Infiltration, *Urban runoff, *Africa, *Urban watersheds, Groundwater recharge, Mathematical models, Runoff, Watersheds, Impervious soils.

A lot of flood damage occurs in African cities due in a large part to a bad conception of storm water drainage. Most of the technical methods used in Africa are European methods, and do not fit the specific conditions of the African watersheds. This is especially true for the problems of sewerage sizing, which is generally solved in Africa by using the well known rational method. However, for most of the African urban watersheds, runoff coefficients cannot be considered as the ratio of impervious areas. This is highlighted with an example of two watersheds that, for a same imperviousness rate equal to 30%, have runoff coefficients that are equal to 60% and 20%, respectively (considering a one year period return rainfall). (See also W90-01612) (Lantz-PTT)
W90-01615

**BLIZZARD INFORMATION SYSTEM AND SNOWING COUNTRY INFORMATION SYSTEM ( IN JAPANESE).**
For primary bibliographic entry see Field 7B.
W90-01733

**INSTRUMENTATION AND SAMPLING METHODS FOR THE SIMPLE CONTROL OF OUTLETS TO AIR AND WATER (INSTRUMENTERING OG PROVETAKING VED ENKEL KONTROLL AV UTSLIPP TIL LUFT OG VANN).**
B. M. Wathne, and H. Hovind.
Available from National Technical Information Service, Springfield, VA 22161 as DE88752094, Price codes: A03 in paper copy, A01 in microfiche. Report NIVA-O-86218, January 1987. 31p, 3 tab, 8 ref, 2 append. In Norwegian.

Descriptors: *Water analysis, *Instrumentation, *Sampling, *Chemical analysis, *Pollutant identification, *Measuring instruments, *Air pollution, *Water pollution, Nitrogen oxides, Carbon monoxide, Heavy metals, Inorganic compounds, Organic compounds.

The report deals with simple sampling and determination methods for discharging pollutants to air and water. Methods for the determination of discharges of volumes of nitrogen oxides, carbon monoxide, sulfur dioxide, and hydrocarbons to air are discussed. In connection with the effluents to water, the sampling procedures for the determination of physical/chemical parameters, main inorganic components, metals, heavy metals, general materials specifications, and some other specifications of the chemical compositions are discussed. The equipments and methods used for the pH and conductivity measurements are described. (Author's Abstract)
W90-01774

**DEVELOPMENT AND EXAMPLE OF USE OF A PROCESS FOR ADEQUATE QUANTIFICATION OF QUALITY OF WATER COURSES (ENTWICKLUNG UND EXEMPLARISCHE ANWENDUNG EINES VERFAHRENS ZUR NUTZUNGSADAEQUATEN QUANTIFIZIERUNG VON GEWAESSERGUETE).**
Technische Hochschule Aachen (Germany, F.R.). Fakultaet fuer Bauingenieur- und Vermessungswesen.
For primary bibliographic entry see Field 5A.
W90-01783

**METHOD OF UNIFORMIZING THE STAGE-DISCHARGE RELATIONS OF STABLE RIVER BEDS AND ITS APPLICATION.**
Yangtze Valley Planning Office, Wuhan (China). Hydrology Dept.
For primary bibliographic entry see Field 7B.
W90-01800

**INSTALLATION AND OPERATION OF A BUBBLE GAUGE NETWORK IN THE MAHAKAM RIVER BASIN, EAST KALIMANTAN, INDONESIA.**
German Agency for Technical Cooperation, Frankfurt am Main (Germany, F.R.).
For primary bibliographic entry see Field 7B.
W90-01811

**HYDROMETRIC DATA CAPTURE USING INTELLIGENT SOLID STATE LOGGING SYSTEMS.**
Severn-Trent Water Authority, Birmingham (England).
S. T. Walker.
IN: Advances in Hydrometry: Proceedings of a symposium held during the First Scientific Assembly of the International Association of Hydrological Sciences at Exeter, U.K., 19-30 July 1982. International Association of Hydrological Sciences Publication 134. 1982. p 229-237.

Descriptors: *Network design, *Rain gages, *Instrumentation, *Stream gages, *Discharge measurement, *Data acquisition, *Hydrometry, Rainfall, England, Computers, Technology, Performance evaluation, Management planning.

From small beginnings with relatively simple rainfall event recorders, the use of solid state logging technology has expanded steadily within the Severn-Trent Water Authority (England) hydrometric service. Ultrasonic and electromagnetic river flow measuring systems now record on intelligent microprocessor driven devices, instead of on the traditional punched paper tape. Further variants with increased versatility have been developed and are undergoing field trials. These include devices with built-in capacity to monitor continuously, but record data only when predetermined threshold values are exceeded, or, to record only significant changes in the state of a variable. The concept of the 'electronic notepad' has been introduced successfully into current meter gauging and shows promise for use in other hydrometric fields. In all cases, great attention has been paid to the 'human engineering' of the devices. Satisfying success has been achieved in making them easily usable by staff previously experienced only with traditional hydrometric equipment. (See also W90-01795) (Author's abstract)
W90-01816

**MONITORING WATER QUANTITY AND WATER QUALITY IN AN URBAN BASIN.**
Rijksdienst voor de Ijsselmeerpolders, Lelystad (Netherlands).
For primary bibliographic entry see Field 7B.
W90-01818

**HADDINGTON FLOOD WARNING SYSTEM.**
Institute of Hydrology, Wallingford (England).
For primary bibliographic entry see Field 7B.
W90-01819

**DETERMINATION OF A MEASURING NETWORK ALONG RIVERS.**
Technische Hogeschool Delft (Netherlands). Dept. of Civil Engineering.
For primary bibliographic entry see Field 7B.
W90-01823

**INTEGRATION OF DIGITAL TERRAIN MODELS INTO GROUND BASED SNOW AND RUNOFF MEASUREMENT.**
Saskatchewan Research Council, Saskatoon.
For primary bibliographic entry see Field 2C.
W90-01882

## 7B. Data Acquisition

**COMBINATION OF RADAR AND GAUGE DATA IN A RAINFALL ARCHIVE SYSTEM.**
For primary bibliographic entry see Field 7A.
W90-00967

**ESTIMATING EVAPORATION FROM UTAH'S GREAT SALT LAKE USING THERMAL INFRARED SATELLITE IMAGERY.**
Brigham Young Univ., Provo, UT. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2D.
W90-00968

**ACCOUNTING FOR DISCREPANCIES IN PAN EVAPORATION CALCULATIONS.**
Everglades National Park, Homestead, FL. South Florida Research Center.
For primary bibliographic entry see Field 2D.
W90-00972

**CLOSED SYSTEM SAMPLE TRANSFER DEVICE FOR VOLATILE ORGANIC COMPOUNDS.**
Wisconsin Univ., Madison. Dept. of Soil Science.
For primary bibliographic entry see Field 5A.
W90-00979

**AUTO-CAD-BASED WATERSHED INFORMATION SYSTEM FOR THE HYDROLOGIC MODEL HEC-1.**
Colorado State Univ., Fort Collins. Dept. of Zoology and Entomology.
For primary bibliographic entry see Field 2E.
W90-00980

**SAGEBRUSH RANGELAND HYDROLOGY AND EVALUATION OF THE SPUR HYDROLOGY MODEL.**
Agricultural Research Service, Boise, ID. Northwest Watershed Research Center.
For primary bibliographic entry see Field 2E.
W90-00981

**KALMAN FILTER CALCULATIONS OF SAMPLING FREQUENCY WHEN DETERMINING ANNUAL MEAN SOLUTE CONCENTRATIONS.**
Colorado State Univ., Fort Collins. Dept. of Earth Resources.
For primary bibliographic entry see Field 7A.
W90-00983

**SIMPLE FLUORIMETRIC DETERMINATION OF ENZYMATIC ACTIVITIES IN VIVO AND OF THE BIOMASS (DNA) ON MICROTITER PLATES (RATIONELLE FLUORIMETRISCHE BESTIMMUNG VON ENZYMAKTIVITATEN IN VIVO UND DER BIOMASSE (DNA) AUF MIKROTITERPLATTEN).**
Wasserforschung Mainz G.m.b.H. (Germany, F.R.).
V. B. Schmitt-Biegel, and U. Obst.
Journal for Water and Wastewater Research ZWABAQ, Vol. 22, No. 4, p 165-167, 1989. 1 tab, 9 ref. English summary.

Descriptors: *Pollutant identification, *Chemical analysis, *Fluorometry, *Enzymes, Biomass, Nucleic acids.

To detect microbial enzyme activities in vivo and the biomass (DNA) in water samples, fluorometric cuvette tests were modified into microtiter plate systems. The detection efficiency of the microtiter-plate enzyme-activity test in vivo is reduced compared with cuvette tests. The DNA-determination detection limits are 10 times higher than with the conventional cuvette test, which means that very dilute samples cannot be analyzed. However, along with the possibility of working with very economical large test series with sufficient internal standards etc., an advantage of these procedures is the option of a simple arrangement of dilution series. But the use of such systems also promises great advantage for enzyme tests if only a small quantity of microtiter plate reading is encountered in water laboratories. The same principles can also be modified to apply to some conventional spectroscopic chemical analyses; these techniques are already in use in recent interesting trends in immunoassays for harmful substance detection (e.g., of plant pesticides). (Author's abstract)
W90-00988

**OXYGEN UPTAKE RATE APPROACH FOR ANALYSING RESPIROMETRIC BIOCHEMICAL OXYGEN DEMAND DATA: I. METHOD DEVELOPMENT.**
McGill Univ., Montreal (Quebec). Dept. of Civil Engineering.
For primary bibliographic entry see Field 5A.
W90-00997

**CHEMICAL OXYGEN DEMAND (COD) USING MICROWAVE DIGESTION.**
Universidade Estadual de Campinas (Brazil). Inst. de Quimica.
W. F. Jardim, and J. J. R. Rohwedder.
Water Research WATRAG, Vol. 23, No. 8, p 1069-1071, August 1989. 2 fig, 1 tab, 6 ref.

Descriptors: *Chemical oxygen demand, *Chemical analysis, Microwaves, Digestion.

A new approach to determine the Chemical Oxygen Demand (COD) using a microwave digestion to replace the conventional time consuming reflux method is proposed. The procedure uses a microwave oven for the digestion of small volumes of samples (from 500 to 2000 micrograms/L), in a completely closed 60 ml Teflon vessel. For samples showing COD values up to 1000 mg 02/L, the digestion step is completed in 7 min, compared to the 2h needed for the conventional reflux methods. An average precision of 1.0% was obtained using membrane filtered natural samples. (Author's abstract)
W90-01007

**METHOD FOR CONSERVING CORE-STORAGE AND COMPUTING TIME IN AQUIFER SIMULATION MODELS.**
Zimbabwe Univ., Harare. Dept. of Geology.
For primary bibliographic entry see Field 7C.
W90-01022

**COMPARISONS OF THE UNSATURATED HYDRAULIC CONDUCTIVITY OF A COARSE-TEXTURED SOIL AS DETERMINED IN THE FIELDS, IN THE LABORATORY, AND WITH MATHEMATICAL MODELS.**
Ghent Rijksuniversiteit (Belgium). Lab. of Soil Physics, Soil Conditioning and Horticultural Soil Science.
For primary bibliographic entry see Field 2G.
W90-01063

**HEMATOLOGICAL ASSESSMENT OF TEMPERATURE AND OXYGEN STRESS IN A RESERVOIR POPULATION OF STRIPED BASS (MORONE SAXATILIS).**
Oklahoma State Univ., Stillwater. Dept. of Zoology.
For primary bibliographic entry see Field 2H.
W90-01064

**DEWATERING SUSPENDED SOLIDS BY CONTINUOUS-FLOW CENTRIFUGATION: PRACTICAL CONSIDERATIONS.**
Envirodata Ltd., Burlington (Ontario).
E. D. Ongley, and R. L. Thomas.
Hydrological Processes HYPRE3, Vol. 3, No. 3, p 255-260, Jul-Sep 1989. 1 tab, 6 ref.

Descriptors: *Centrifugation, *Quality control, *Clarifiers, *Sediment sampler, *Laboratory equipment, Field tests, Metals, Phosphorus, Organic compounds, Particle size, Bioassay.

Practical considerations for soil-testing centrifuges were examined for the Westfalia and the Alfa-Laval machines. The Westfalia clarifier is a four chamber, bowl centrifuge while the Alfa-Laval uses a disc separation technique. The Westphalia is not designed for portable use, but can be re-engineered for this purpose. A specially modified Alfa-Laval centrifuge is manufactured for portable use and is available commercially in configurations for immediate field use. Several studies on sample contamination when using these centrifuges have reported conflicting results. Sample size with both centrifuges is commonly of the order of several to tens of grams of recovered sediment. The lower amount is for metals, phosphorus, particle sizing, etc. and the higher amount for organic contaminant analysis and bioassay. Spare parts may be a problem for both centrifuges in the portable mode and may require several months to obtain. It is recommended that some of the non-standard spare parts be held in inventory. (Peters-PTT)
W90-01075

**APPLICATION OF GENE PROBE METHODS FOR MONITORING SPECIFIC MICROBIAL POPULATIONS IN FRESHWATER ECOSYSTEMS.**
Louisville Univ., KY. Dept. of Biology.
For primary bibliographic entry see Field 5A.
W90-01111

**HYDROLOGICAL RADAR: RESULTS AND EXPERIMENTS CURRENTLY BEING CONDUCTED IN FRANCE (HYDROLOGIE RADAR: BILAN ET PERSPECTIVES).**
Institut de Mecanique de Grenoble, Saint-Martin d'Heres (France).
H. Andrieu, J. D. Creutin, G. Delrieu, J. Fournet, and Y. Pointin.
La Houille Blanche HOBLAB, Vol. 5, No. 6, p 457-465, 1988. 1 tab, 6 fig, 18 ref. English summary.

Descriptors: *Data acquisition, *Remote sensing, *Radar, *Weather forecasting, *France, *Flood forecasting, Floods, Rainfall.

The use of radar in hydrological studies during the last few years in France has indicated the limitation of this measurement technique for the quantitative evaluation and the forecast of rainfall. These initial results are based on many experiments specifically devoted to hydrology. Recent research both in France and abroad is briefly reviewed. The results obtained from the Radar-Cevennes are reported. The role of the double polarization measurement technique in standardizing radar data and the need to integrate a radar in a flood announcement system are discussed. (Peters-PTT)
W90-01139

**EFFECT OF THE INCUBATION TEMPERATURE ON THE ISOLATION OF AEROBIC HETEROTROPHIC BACTERIA FROM A RIVER.**
Nihon Univ., Tokyo. Dept. of Fisheries.
H. Sugita, M. Tamura, and Y. Deguchi.
Nippon Suisan Gakkaishi (Bulletin of the Japanese Society of Scientific Fisheries) NSUGAF, Vol. 55, No. 5, p 829-835, May 1989. 1 fig, 6 tab, 12 ref.

Descriptors: *Pollutant identification, *Culturing techniques, *Bacteria, *Incubation, *Temperature, Gram-negative bacteria, Achromogenic bacteria, Seasonal variation, Rivers.

Samples of the water and sediment were collected at midstream and downstream sites of the Tama River from January to December 1983, and incubated aerobically at 5, 10, 20, 30, and 37 C after plating onto 1/20 PYBGF and PYBGF agar plates. As a result, the maximum colony counts were obtained at 20 C of incubation temperature,

and Gram-negative, achromogenic bacteria predominated in almost all samples throughout the year, irrespective of the incubation temperatures. However, suspected psychrophiles and mesophiles were isolated at the low incubation temperatures in the colder season and the higher temperatures in the warmer season, respectively. These results suggested that the samples from freshwater environments in the summer and winter seasons, should be incubated at 20 C, and the ambient temperature samples if the more diverse microflora including either psychrophiles or mesophiles is needed to be isolated. (Author's abstract)
W90-01168

**DETERMINATION OF TRACE METALS IN REFERENCE WATER STANDARDS BY INDUCTIVELY COUPLED PLASMA MASS SPECTROMETRY WITH ON-LINE PRECONCENTRATION.**
National Research Council of Canada, Ottawa (Ontario). Div. of Chemistry.
For primary bibliographic entry see Field 5A.
W90-01237

**LABORATORY STUDY OF THE EFFECTS OF WATERBORNE CADMIUM, CALCIUM, AND CARBONATE CONCENTRATIONS ON CADMIUM CONCENTRATIONS IN HYALLELA AZTECA (CRUSTACEA: AMPHIPODA).**
Guelph Univ. (Ontario). Dept. of Zoology.
For primary bibliographic entry see Field 5C.
W90-01245

**DEVELOPMENT AND EVALUATION OF A NOVEL MARINE SEDIMENT PORE WATER TOXICITY TEST WITH THE POLYCHAETE DINOPHILUS GYROCILIATUS.**
Battelle Ocean Sciences, Duxbury, MA.
For primary bibliographic entry see Field 5C.
W90-01262

**IN SITU HYDRAULIC CONDUCTIVITY TESTS FOR COMPACTED CLAY.**
Texas Univ., Austin. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2G.
W90-01273

**SPECIATION OF ALUMINUM, CADMIUM, COPPER, AND LEAD IN HUMIC SOIL SOLUTIONS: A COMPARISON OF THE ION EXCHANGE COLUMN PROCEDURE AND EQUILIBRIUM DIALYIS.**
Lund Univ. (Sweden). Dept. of Ecology.
For primary bibliographic entry see Field 5B.
W90-01279

**SPECIFIC PROCEDURE FOR METAL SOLID SPECIATION IN HEAVILY POLLUTED RIVER SEDIMENTS.**
Barcelona Univ. (Spain). Dept. of Analytical Chemistry.
For primary bibliographic entry see Field 5A.
W90-01281

**OPTIMIZATION OF TESSIER PROCEDURE FOR METAL SOLID SPECIATION IN RIVER SEDIMENTS.**
Barcelona Univ. (Spain). Dept. of Analytical Chemistry.
For primary bibliographic entry see Field 5A.
W90-01282

**DETERMINATION OF HEAVY METAL POLLUTION BY ICP AND AAS IN THE SUSPENDED MATTER OF THE GULF OF CADIZ.**
Instituto de Ciencias del Mar, Barcelona (Spain).
For primary bibliographic entry see Field 5A.
W90-01283

**EXTRACTION-SPECTROPHOTOMETRIC DETERMINATION OF CHROMIUM(VI) WITH HYDROXYAMIDINE AND AMIDES.**
Ravishankar Univ., Raipur (India). Dept. of Chemistry.
For primary bibliographic entry see Field 5A.
W90-01284

**DETERMINATION OF MERCURY IN SURFACE WATERS USING AN OPTIMIZED COLD VAPOR SPECTROPHOTOMETRIC TECHNIQUE.**
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5A.
W90-01285

**DETERMINATION OF NUTRIENT UPTAKE KINETIC PARAMETERS: A COMPARISON OF METHODS.**
British Columbia Univ., Vancouver. Dept. of Oceanography.
For primary bibliographic entry see Field 2H.
W90-01290

**MICROAUTORADIOGRAPHIC STUDY OF THYMIDINE UPTAKE IN BRACKISH WATERS AROUND SAPELO ISLAND, GEORGIA, USA.**
Universidad Autonoma de Barcelona (Spain). Dept. of Genetics and Microbiology.
For primary bibliographic entry see Field 2L.
W90-01291

**SPECIATION PHOSPHORUS TECHNIQUES IN THE SEDIMENTS: DISCUSSION AND PROPOSITIONS TO EVALUATE INORGANIC AND ORGANIC PHOSPHORUS (LES METHODES DE SPECIATION DU PHOSPHORE DANS LES SEDIMENTS: CRITIQUES ET PROPOSITIONS POUR L'EVALUATION DES FRACTIONS MINERALES ET ORGANIQUES).**
Rennes-1 Univ. (France). Lab. d'Evolution des Systemes.
For primary bibliographic entry see Field 2H.
W90-01302

**USE OF REMOTS TECHNOLOGY IN MONITORING COASTAL ENRICHMENT RESULTING FROM MARICULTURE.**
University Coll., Galway (Ireland). Dept. of Zoology.
B. D. S. O'Connor, J. Costelloe, B. F. Keegan, and D. C. Rhoads.
Marine Pollution Bulletin MPNBAZ, Vol. 20, No. 8, p 384-390, August 1989. 7 fig, 1 tab, 4 ref.

Descriptors: *Remote sensing, *Photography, *Coastal waters, *Monitoring, *Environmental protection, *Aquaculture, Computer image analysis, Marine sediments.

REMOTS technology is a combination of sediment-profile imagery and computer image analysis. With it, one can deduce the dynamics of biological and physical seafloor processes from imaged structures. The equipment is easy to deploy and broad areal coverage can be accomplished in a very short time. The data return is equally rapid, allowing the implementation of management decisions which are based on 'real time' information rather than the 'after the fact' remedial actions imposed by the more traditional surveying/monitoring methods. (Author's abstract)
W90-01331

**IN SITU ACOUSTIC MEASUREMENTS OF MARINE GRAVEL THRESHOLD AND TRANSPORT.**
Proudman Oceanographic Lab., Birkenhead (England).
For primary bibliographic entry see Field 2J.
W90-01357

**RESOLUTION CONSIDERATIONS IN USING RADAR RAINFALL DATA FOR FLOOD FORECASTING.**
Waterloo Univ. (Ontario). Dept. of Chemical Engineering.
For primary bibliographic entry see Field 2B.
W90-01365

**COMPARISON OF TWO GRAVITY CORING DEVICES FOR SEDIMENTATION RATE MEASUREMENT BY PB210 DATING TECHNIQUES.**
Washington Univ., Seattle. Lab. of Radiation Ecology.
For primary bibliographic entry see Field 2J.
W90-01376

**COMPARISON OF THE ABILITIES OF 15 MEDIA TO RECOVER VIABLE YEASTS FROM POND, RIVER, AND LAKE WATER.**
National Water Research Inst., Burlington (Ontario). Research and Applications Branch.
For primary bibliographic entry see Field 5A.
W90-01379

**STATISTICAL CHARACTERISTICS OF RADAR ECHOES OF PRECIPITATING SNOW CLOUDS OVER THE ISHIKARI BAY, HOKKAIDO, JAPAN.**
Hokkaido Univ., Sapporo (Japan). Dept. of Geophysics.
For primary bibliographic entry see Field 2B.
W90-01390

**FEASIBILITY OF USING SATELLITES FOR DETECTION OF KINETICS OF SMALL PHYTOPLANKTON BLOOMS IN ESTUARIES: TIDAL AND MIGRATIONAL EFFECTS.**
Versar, Inc., Columbia, MD.
M. A. Tyler, and R. P. Stumpf.
Remote Sensing of the Environment RSEEA7, Vol. 27, No. 3, p 233-250, March 1989. 9 fig, 30 ref.

Descriptors: *Remote sensing, *Satellite technology, *Phytoplankton, *Eutrophication, *Estuaries, *Tidal effects, *Aquatic environment, *Algae, Population distribution, Chesapeake Bay, Aquatic plants, Algorithms.

It is shown that reliable and accurate measurements of fine-scale pigment distribution in a turbid estuarine environment is feasible and desirable using an algorithm developed earlier by the authors, along with satellite imagery, to determine algal migration, bloom origins, dissipation, tidal spatial reconfiguration, and population dynamics. The value of these tools is demonstrated in designing sampling strategies. The Chesapeake Bay and its major tributaries was used to illustrate the feasibility of this approach during the spring 1982 season. AVHRR and CZCS imagery processed with the algorithms for turbid systems confirmed the kinetics of a 100 sq km bloom of the dinoflagellate Heterocapsa triquetra, including abundance changes due to diurnal migration, and axial and cross stream spatial reconfiguration due to tidal excursion. Turbidity and thermal information gleaned from both satellite and ships emphasized the association of blooms with physical features of the system such as fronts. Thus, remote detection and rapid monitoring of bloom kinetics in turbid estuaries is feasible. (Friedmann-PTT)
W90-01393

**MAPPING SURFACE SOIL MOISTURE WITH L-BAND RADIOMETRIC MEASUREMENTS.**
National Aeronautics and Space Administration, Greenbelt, MD. Goddard Space Flight Center.
For primary bibliographic entry see Field 2G.
W90-01394

**EFFECT OF FOREST BIOMASS ON AIRBORNE SNOW WATER EQUIVALENT ESTIMATES OBTAINED BY MEASURING TERRESTRIAL GAMMA RADIATION.**
Arizona State Univ., Tempe. Dept. of Decision and Information Systems.
S. S. Carroll, and T. R. Carroll.
Remote Sensing of the Environment RSEEA7, Vol. 27, No. 3, p 313-320, March 1989. 2 fig, 23 ref.

Descriptors: *Forest hydrology, *Remote sensing, *Atmospheric water, *Snow, *Snowmelt, *Biomass, *Forests, *Gamma radiation, Snow density, Snow surveys.

The nature of the downward bias in the estimate of snow water equivalent due to forest biomass is examined. A means for correcting this bias, which depends on the amounts of biomass and radioactive material in the biomass, is presented. The method presented is a first approximation model of the effects of forest biomass on airborne snow water equivalent estimates. It is shown that when the snowpack is very deep, even small amounts of biomass can cause a large errors in the estimate. Conversely, for areas of shallow snow, the biomass presents a problem only when it exists in large quantities. Also, for areas of deep snow, the estimate of the snow water equivalent is very sensitive to the small changes in the weight of the biomass. Hence, for deep snow conditions, it is not only critical to account for the biomass, it is also critical to obtain an accurate estimate of the biomass. The methodology presented can aid National Weather Service hydrologists in improving river and flood forecasts, water supply forecasts, and spring flood outlooks for large areas of the U.S. and Canada. (Friedmann-PTT)
W90-01395

**QUALITY OF SATELLITE PRECIPITABLE WATER CONTENT DATA AND THEIR IMPACT ON ANALYZED MOISTURE FIELDS.**
European Centre for Medium Range Weather Forecasts, Reading (England).
L. Illari.
Tellus TELLAL, Vol. 41A, No. 4, p 319-337, August 1989. 16 fig, 26 ref.

Descriptors: *Satellite technology, *Remote sensing, *Atmospheric water, *Precipitation, *Clouds, *Meteorological data collection, Weather, Weather data collections, Rain.

The quality of satellite Precipitable Water Content (PWC) moisture data is assessed by comparing them with radiosondes and the first-guess humidity field from the ECMWF operation model. Collocation studies show that PWC data from satellites are of comparable quality to radiosonde data and that the error in the inferred relative humidity varies from 15% in the Tropics to 35% in the extratropics, similar to the typical error levels of radiosonde humidity data. The model first-guess provides moisture information of comparable accuracy. Using a large sample of radiosonde and first-guess moisture information over North America, the typical forecast error correlation scale for the humidity analysis variable has been found to be 250 km at the surface rising to 300 km at upper levels. Finally, impact studies have shown that the inclusion of satellite PWC data in the ECMWF humidity analysis has a small but beneficial impact on the forecast, especially of the forecast rain in the Tropics. (Author's abstract)
W90-01396

**SEMI-AUTOMATIC METHOD TO QUANTIFY AND IDENTIFY ZOOPLANKTON.**
Hydrological Research Inst., Pretoria (South Africa).
For primary bibliographic entry see Field 2H.
W90-01402

**FLOW-INJECTION ANALYSIS OF SUBSTANCES IN WATER: PART II. CATIONS, A CRITICAL REVIEW.**
Pretoria Univ. (South Africa). Dept. of Chemistry.
For primary bibliographic entry see Field 5F.
W90-01405

**TEMPERATURE DATA AVAILABLE ON THE DEPARTMENT OF WATER AFFAIRS' CHEMICAL DATA BASE.**
Hydrological Research Inst., Pretoria (South Africa).
M. R. Howard.
Water SA WASADV, Vol. 15, No. 3, p 195-198, July 1989. 3 fig, 1 tab.

Descriptors: *Water temperature, *Water quality, *South Africa, Sampling, Sample preparation.

The Chemical Data Base operated by the Department of Water Affairs, South Africa, contains information regarding the chemical components in South African rivers. This report examines the temperature data available on the data base and examines the long-term record for four sampling stations chosen at random. Errors were detected in the data base and these were broadly typographical and measurement errors, such as a thermometer possibly lying in the sun inside a car; also, the water temperature may be measured once the water is in the bottle and already a few degrees higher than the flowing water. These potential problem areas are being investigated by the Directorate: Hydrology and so should occur less frequently from now on. (Author's abstract)
W90-01407

**SAHELIAN DROUGHT(S) AS SEEN FROM THE RAINFALL DATA OF A MAURITANIAN STATION.**
Institut Royal Meteorologique de Belgique, Brussels. Hydrology Section.
G. Demaree, and M. S. Chadilly.
IN: Computer Methods and Water Resources: First International Conference, Morocco, 1988. Vol. 3, Computational Hydrology. Computational Mechanics Publications, Boston. 1988. p 15-23, 4 fig, 31 ref.

Descriptors: *Drought, *Arid lands, *Semiarid lands, *Fluctuations, *Rainfall, *Arid climates, *Climatic data, Statistical analysis, Precipitation, Meteorological data collection, Environmental effects.

In recent years, with the heightened awareness of a fluctuating or changing climatic environment, due to intrinsic dynamic causes and/or to the impact of human activities, the interest in the analysis of long-term instrumental time series has been renewed. Daily precipitation depths at the station Kaedi are available since 1904, constituting Mauritania's longest record. Utilization of HOMS-components permits investigation, from this series, of the succession of the dry and wet periods of this century. From this data, it is inferred that the existence of a statistically significant downward trend in the yearly precipitation depths, a splitting up of the reference period 1904-1987 into two statistically significant periods different in the mean, and a considerable decrease in the length of the rainy season. (See also W90-01409) (Author's abstract)
W90-01411

**SYSTEM FOR WEATHER-BASED ANALYSIS OF DROUGHT IN AFRICA.**
Agriculture Canada, Ottawa (Ontario). Soil and Climate Section.
J. A. Dyer.
IN: Computer Methods and Water Resources: First International Conference, Morocco, 1988. Vol. 3, Computational Hydrology. Computational Mechanics Publications, Boston. 1988. p 25-36, 3 fig, 10 ref.

Descriptors: *Computer programs, *Drought, *Arid lands, *Semiarid lands, *Arid climates, *Africa, *Meteorological data collection, *Soil moisture deficiency, Soil water, Model studies, Root zone, Mathematical studies, Soil water potential, Rainfall, Hydrology.

A computer system for weather-based analysis of drought in Africa is described. The major goal of the system is to predict changes in crop growing conditions by analysis of weather records using computer simulation. Other goals include relating current growing conditions to historical expectations to define the level of abnormality currently being experienced, and providing more concentrated analysis and identification of areas currently under high risk.. The scale of the monitoring system is the entire African continent. Drought impacts on pasture and field crops are represented by three basic variables: accumulated rainfall, soil moisture at the end of the month, and crop water use during the growing season. A monthly time-frame model was formulated to account for different soil water capacities, drying patterns, crop root densities and initial soil water contents. The soil moisture loss equation from the Versatile Soil Moisture Budget was simplified to one layer of soil, and the equation is applied to a monthly time frame four times each month. The main output of the system is cartographic-isolines that enclose all weather stations whose current estimates are below a selected criteria threshold level. (See also W90-01409) (Friedmann-PTT)
W90-01412

**COMPARISON OF EFFECTIVE RAINFALL SEPARATION TECHNIQUES APPLIED TO THE DERIVATION OF CATCHMENT AVERAGE UNIT HYDROGRAPHS.**
Queen Mary Coll., London (England).
P. R. Wormleaton.
IN: Computer Methods and Water Resources: First International Conference, Morocco, 1988. Vol. 3, Computational Hydrology. Computational Mechanics Publications, Boston. 1988. p 87-96, 1 fig, 1 tab, 3 ref.

Descriptors: *Unit hydrographs, *Catchment areas, *Storm runoff, *Hydrographs, *Rainfall-runoff relationships, *Runoff, Basins, *Model studies, Comparison studies, Rainfall impact, Hydrologic models, Hydrologic properties, Mathematical equations, Storm surges.

The consistency of the unit hydrographs obtained from a number of varying storm events over a catchment was used to compare several loss models using data from four catchments in Essex, England. In comparing these consistencies between storms, a multiple storm concatenation method was used, which derives a catchment average unit hydrograph. The coefficient of multiple determination, obtained from the rainfall/runoff relationships defining all of the storms, was used as a measure of unit hydrograph consistency. It was thought, that with other sources of error being either small or consistent, the coefficient of multiple determination should reflect the validity of the linearity assumptions for a catchment, and may also be used as a comparative yardstick between rainfall loss models. Three such models for comparing losses were used. Of these, it was shown that a percentage loss rate model was the most reliable with non-synchronized data. This investigation demonstrated that a marked improvement in the fit of the unit hydrograph equations can be brought about by synchronizing the effective rainfall and storm runoff. (See also W90-01409) (Friedmann-PTT)
W90-01417

**USE OF LYSIMETER MEASUREMENTS FOR ESTIMATION OF THE EVAPOTRANSPIRATION OF PINE FOREST BY BAGROV'S METHOD.**
Humboldt-Univ. zu Berlin (German D.R.). Sektion Physik.
For primary bibliographic entry see Field 2D.
W90-01465

**CHEMICAL DEGRADATION OF HUMIC SUBSTANCES FOR STRUCTURAL CHARACTERIZATION.**
North Carolina Univ., Chapel Hill. Dept. of Environmental Sciences and Engineering.
L. B. Sonnenberg, J. D. Johnson, and R. F. Christman.
IN: Aquatic Humic Substances: Influence on Fate and Treatment of Pollutants. American Chemical Society, Washington, DC. 1989. p 3-23, 2 fig, 3 tab, 3 charts, 61 ref.

Descriptors: *Chemical analysis, *Humic acids, *Chemical degradation, Degradation, Chemical properties.

Chemical degradations of humic substances are reviewed, with emphasis on the identity of the products and how these compounds relate to the overall structure of the humic macromolecule. The

methods described include (1) reduction using metals, hydrogen, and metal hydrides; (2) oxidation with copper oxide, permanganate, and chlorine; and (3) alkaline hydrolysis. Experimental results are reported for the reductive and solvolytic degradation of isolated aquatic humic acid using metallic sodium dissolved in liquid ammonia. A number of highly oxygenated compounds, many that commonly result from oxidative procedures, are identified in the reduction mixture. The presence of these structures in the original humic macromolecule is suggested. (See also W90-01491) (Author's abstract)
W90-01492

**CHARACTERIZATION OF A STREAM SEDIMENT HUMIN.**
Colorado School of Mines, Golden. Dept. of Chemistry and Geochemistry.
For primary bibliographic entry see Field 2K.
W90-01494

**ANALYSIS OF HUMIC SUBSTANCES USING FLOW FIELD-FLOW FRACTIONATION.**
Chisholm Inst. of Tech., Melbourne (Australia). Water Studies Centre.
R. Beckett, J. C. Bigelow, Z. Jue, and J. C. Giddings.
IN: Aquatic Humic Substances: Influence on Fate and Treatment of Pollutants. American Chemical Society, Washington, DC. 1989. p 65-80, 7 fig, 2 tab, 39 ref. U.S. Department of Energy Grant DE-FG02-86ER60431.

Descriptors: *Chemical analysis, *Water analysis, *Humic acids, Separation techniques, Molecular structure, Detection methods, Chemical properties.

A new method for the determination of molecular-weight distributions of humic substances using flow field-flow fractionation (flow FFF) is outlined. Fairly good agreement between the results obtained by flow FFF and other methods for some humic reference substances was achieved using poly (styrene sulfonate) molecular-weight calibration standards. The molecular-weight distributions obtained for a variety of humic samples were all fairly broad and, in contrast to the data sometimes reported for gel permeation chromatography, did not show any indication of multiple peaks. The number-average and weight-average molecular weights can be estimated, and these were shown to vary considerably (M from about 4400 to 19,000) for humic acids extracted from different environments. The method is also capable of fractionating a humic sample. However, because it is a very small-scale separation (<1 mg of sample), quite sensitive analytical detection methods would be required to make use of this feature. (See also W90-01491) (Author's abstract)
W90-01496

**SEPARATION OF HUMIC SUBSTANCES AND ANIONIC SURFACTANTS FROM GROUND WATER BY SELECTIVE ADSORPTION.**
Kansas State Geological Survey, Lawrence.
For primary bibliographic entry see Field 5A.
W90-01499

**METHODS FOR DISSOLVING HYDROPHOBIC COMPOUNDS IN WATER: INTERACTIONS WITH DISSOLVED ORGANIC MATTER.**
Manitoba Univ., Winnipeg. Dept. of Soil Science.
For primary bibliographic entry see Field 5B.
W90-01508

**BAYESIAN FORECASTING OF HYDROLOGIC VARIABLES UNDER CHANGING CLIMATOLOGY.**
Arizona Univ., Tucson. Dept. of Systems and Industrial Engineering.
L. Duckstein, B. Bobee, and I. Bogardi.
IN: The Influence of Climate Change and Climatic Variability on the Hydrologic Regime and Water Resources, International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication No. 168, 1987. p 301-311, 2 fig, 17 ref.

Descriptors: *Flood forecasting, *Runoff forecasting, *Streamflow forecasting, *Hydrologic data, *Climatology, *Forecasting, Statistical methods, Rivers, Canada.

A Bayesian framework is developed to provide a credible set (or Bayesian confidence interval) to forecast hydrologic parameters under uncertainty of climatologic changes. The methodology is illustrated by developing the forecast for the credible set of parameters of the distribution of flow exceedance x of a Canadian river. In the case study, only the mean is assumed to be unknown so as to simplify the presentation. A random variable (u) is taken as a function of the climatologic regime. A prior distribution of the mean u of future flood pi(u) can be estimated using one or a combination of various techniques. As new observations on climatology and floods become available, the posterior distribution and credible sets can be routinely be updated. (See also W90-01537) (Author's abstract)
W90-01564

**REMOTE SENSING OF WATERSHED CHARACTERISTICS AND RAINFALL INPUT.**
Ruhr Univ., Bochum (Germany, F.R.).
G. A. Schultz.
IN: Unsaturated Flow in Hydrologic Modeling: Theory and Practice. Kluwer Academic Publishers, Boston. 1989. p 301-323, 16 fig, 1 tab, 15 ref.

Descriptors: *Radar, *Remote sensing, *Satellite technology, *Model studies, *Rainfall, Hydrologic models, Mathematical models, Watershed management, Vegetation effects, Groundwater, Evapotranspiration, Snowmelt, Aeration zone, Data acquisition.

Modern hydrologic modeling techniques require information on the hydrological system as well as on the hydrologic process with high resolution in space and time. Conventional point measurements are not very suitable for this purpose, while various remote sensing (RS) techniques are of great advantage in many cases. After a brief discussion of RS platforms and sensors relevant for hydrological applications, techniques are discussed which can estimate catchment characteristics with the aid of satellite data. Landsat TM and SPOT satellites provide relevant information in various spectral bands which allows the estimation of soil type, land use, vegetation canopy, soil moisture conditions etc. which may form the basis for the estimation of hydrologic model parameters. RS data can also be used for the quantification of model input variables such as rainfall, snowmelt, evapotranspiration and so on. Two RS techniques for rainfall estimation are presented, i. e. radar rainfall measurement (active microwave) and rainfall estimation by data from satellite imagery (infrared and visible). While the use of weather radar provides a high resolution in time and space and is already operational in real time, the satellite imagery produces rainfall estimates of lesser accuracy. It will, however, be improved during the 1990's and provides a promising perspective for the future. (See also W90-01590) (Author's abstract)
W90-01601

**CONSTANT HEAD PERCOLATION TEST-IMPROVED EQUIPMENT AND POSSIBILITIES OF ASSESSING THE SATURATED HYDRAULIC CONDUCTIVITY.**
Norges Landbrukshoegskole, Aas. Inst. for Georesources and Pollution Research.
For primary bibliographic entry see Field 2G.
W90-01609

**CONCERNING THE EXPERIMENTAL MEASUREMENTS OF INFILTRATION FOR THE RUNOFF MODELISATION OF THE URBAN WATERSHEDS IN WESTERN AFRICA.**
Office de la Recherche Scientifique et Technique Outre-Mer, Montpellier (France).
For primary bibliographic entry see Field 7A.
W90-01615

**ESTIMATING THE RELIABILITY OF REGIONAL PREDICTIONS OF AQUATIC EFFECTS OF ACID DEPOSITION.**
Oak Ridge National Lab., TN. Environmental Sciences Div.
For primary bibliographic entry see Field 5C.
W90-01724

**CHEMICAL CHARACTERISTICS OF STREAMS IN THE MID-ATLANTIC AND SOUTHEASTERN UNITED STATES (NATIONAL STREAM SURVEY-PHASE I). VOLUME II: STREAMS SAMPLED, DESCRIPTIVE STATISTICS, AND COMPENDIUM OF PHYSICAL AND CHEMICAL DATA.**
Environmental Protection Agency, Washington, DC. Office of Acid Deposition, Environmental Monitoring, and Quality Assurance.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-119614. Price codes: A99 in paper copy, A01 in microfiche. Report No. EPA/600/3-88/021b, June 1988. 595p, 339 fig, 18 tab, 12 ref. EPA Contracts 68-03-3249 and 68-02-3889.

Descriptors: *Water chemistry, *Data collections, *Acid rain, *Streams, *Water quality, *Data collections, *Acidic water, Maps, Physical properties, Chemical properties, Chemical analysis.

National Stream Survey Phase I (NSS-I) field activities were conducted in the Mid-Atlantic and Southeastern U.S. in the spring of 1986 by the US EPA as part of the National Surface Water Survey and the National Acid Precipitation Assessment Program. The Survey employed a probability sample of 500 stream reaches representing a region population of 64,700 reaches portrayed as blue lines on 1:250,000 scale maps and which have drainage areas < 155 sq km. This, Volume II of the report, presents all of the data collected during this survey including: subregion maps, stream names and locations, population estimates for selected physical and chemical variables, physical data listings, and chemical data listings. (Lantz-PTT)
W90-01728

**ALGAE FLUORESCENCE TEST AS A SENSITIVE BIOTEST ON ALGICIDE SUBSTANCES IN SURFACE WATER (ALGEN-FLUORESZENZTEST ALS EMPFINKLICHER BIOTEST AUF ALGIZIDE SUBSTANZEN IM OBERFLAECHENWASSER).**
Umweltbundesamt, Berlin (Germany, F.R.).
For primary bibliographic entry see Field 5A.
W90-01730

**BLIZZARD INFORMATION SYSTEM AND SNOWING COUNTRY INFORMATION SYSTEM ( IN JAPANESE).**
S. Sato, and Y. Tsuchiya.
In: Taisei Technical Research Report 20. p 15-22, 13 fig, 5 tab. English summary.

Descriptors: *Data acquisition, *Meteorology, *Blizzards, *Weather patterns, *Weather forecasting, Wind, Mapping, Climates, Prediction, Temperature.

The problems in heavy snow areas now and in the future are described, and countermeasures proposed, using a blizzard as an example. It has been demonstrated that the P sub b index, which is a function of wind velocity (m/s) and temperature (C), is useful for blizzard prediction. The records obtained in Shonal Plain show that a severe blizzard occurs in the same day, if the P sub b index obtained at 6:00 am is larger than 8-9. It seems to be possible to apply this P sub b index to other areas by taking the local conditions into consideration. A certain pattern in climate maps seems to be useful for blizzard prediction for several days. In Aomori and Yamagata districts, the prediction of blizzard two days later was satisfactorily made to some extent by knowing the east latitude at which the equi-pressure line of 1020 mb crosses with 40 degrees north longitude. An improved method for blizzard prediction in blizzard areas

will be established by continuing this pattern analysis for several years. The effort to systematize this method also will be necessary for general application of this method to the areas concerned. These values and functions may be introduced in a 'Blizzard Information System' and, hopefully in the future, in 'Snowing Country Information System', from which a wide range of users can obtain more accurate information relating to snow at an earlier time. (Author's abstract)
W90-01733

**GC/MS IDENTIFICATION OF MUTAGENS IN AQUEOUS CHLORINATED HUMIC ACID AND DRINKING WATERS FOLLOWING HPLC FRACTIONATION OF STRONG ACID EXTRACTS.**
Environmental Protection Agency, Cincinnati, OH.
For primary bibliographic entry see Field 5F.
W90-01759

**APPLICATIONS OF OPTICAL EMISSION SPECTROSCOPY WITH INDUCTIVELY HEATED ARGON PLASMA TORCH IN THE ANALYSIS OF ENVIRONMENTAL MATERIALS (UNTERSUCHUNGEN ZU EINSATZMOGLICHKEITEN DER OPTISCHEN EMISSIONSSPEKTROMETRIE MIT INDUKTIV GEHEIZTER ARGONPLASMAFACKEL BEI DER ANALYSE VON UMWELTPROBEN).**
GKSS - Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.)
For primary bibliographic entry see Field 5A.
W90-01773

**DEVELOPMENT AND EXAMPLE OF USE OF A PROCESS FOR ADEQUATE QUANTIFICATION OF QUALITY OF WATER COURSES (ENTWICKLUNG UND EXEMPLARISCHE ANWENDUNG EINES VERFAHRENS ZUR NUTZUNGSADAEQUATEN QUANTIFIZIERUNG VON GEWAESSERGUETE).**
Technische Hochschule Aachen (Germany, F.R.). Fakultaet fuer Bauingenieur- und Vermessungswesen.
For primary bibliographic entry see Field 5A.
W90-01783

**ADVANCES IN HYDROMETRY.**
International Association of Hydrological Sciences.
Proceedings of a symposium held during the First Scientific Assembly of the International Association of Hydrological Sciences at Exeter, U.K., 19-30 July 1982. International Association of Hydrological Sciences Publication 134. 1982. 359p. Edited by J. A. Cole.

Descriptors: *Stream gages, *Instrumentation, *Discharge measurement, *Hydrometry, *Measuring instruments, *Flow discharge, Technology transfer, Field tests, Current meters, Floods, Symposium.

Hydrometry deals with the physical measurement of terrestrial waters, which may be flowing above or below ground, or quasistatic in lakes, reservoirs, and underground formations. This volume contains contributions covering four main approaches to discharge measurement (current metering and gauging, discharge measurement by moving-boat and related techniques, float and tracer techniques, and ultrasonic and electromagnetic techniques) and discussions of hydrometry in the electronic age and regional hydrometry, for a total of 32 papers. Specific topics are as follows: trends in the development of hydrology; hydrometric cableways in the Yangtze Valley (China); flow measurement in open and closed conduits of urban storm sewer networks; individual rating versus group rating in current meter calibration; up-dating discharge rating curves with mathematical models; uniformizing the stage-discharge relations of stable river beds and its application; equations for estimating discharge in steep channels with coarse bed materials; the multilayer width-integrated velocity measurement method; moving-boat discharge measurements using acoustic Doppler techniques; developments in hydrometry in India; instrumentation required for the measurement of discharge by the moving boat method; Sahelian hydrometry; flood flow gauging with tritium in southern Africa; tracer measurements in lowland rivers; two less conventional methods of flow gauging; the rising air float technique for the measurement of stream discharge; a bubble gauge network for the Mahakam River Basin, Indonesia; determination of the accuracy of water level observations; improvement of ultrasonic flowmeters in rivers in Japan; hydraulic investigations on the cooling water system of a thermal power station; the measurement of open channel flow by the electromagnetic gauge; hydrometric data capture using intelligent solid state logging systems; flow measurement at sewage treatment plants; monitoring water quantity and water quality in an urban basin; the Haddington (Scotland) flood warning system; satellite data for the estimation of rainfall and runoff; a warning system compatible with randomly timed polar satellites (oil spill warning systems); design of a measurement network along rivers; hydrometry of karst regions; hydrometry in Central American and Brazil; automation of daily water discharge computation for rivers with different regimes; and advanced hydrologic instrumentation activities of the Water Resources Division, U.S. Geological Survey. (See W90-01796 thru W90-01827) (Rochester-PTT)
W90-01795

**HYDROMETRIC CABLEWAYS IN THE YANGTZE VALLEY.**
Yangtze Valley Planning Office, Wuhan (China). Hydrology Dept.
Y.-L. Chen, and G.-Z. Zhong.
IN: Advances in Hydrometry: Proceedings of a symposium held during the First Scientific Assembly of the International Association of Hydrological Sciences at Exeter, U.K., 19-30 July 1982. International Association of Hydrological Sciences Publication 134. 1982. p 7-17, 7 fig, 2 tab, 3 ref.

Descriptors: *Instrumentation, *Cableways, *China, *Hydrometry, *Measuring instruments, Hydrometric cableways, Field tests, Mathematical equations, Performance evaluation, Yangtze River Valley.

The hydrometric cableway is the principal measuring device in the Yangtze Valley (China) for deep, swiftly flowing and violently fluctuating streams. Technical problems associated with the use of hydrometric cableways are described. These problems include layout of the cable, principles and methods of depth measurements using a sounding weight, measures of eliminating the effects of cable vibration, signal transmission and remote operation for velocity, depth, and sediment measurements, and instruments and methods for depth and sediment measurements. Among the conditions that must be evaluated when using the hydrometric cableway are droop of the main cable, rise of the hanging point, increase in operating cable length, and variation in curve length. Equations are provided for evaluating these factors. Stepwise speed regulation of the powered winch gives rise to cable oscillation and makes positioning of the suspension cable and current meter difficult. Chinese hydrologists since the 1970s having been using silicon-controlled stepless speed regulation of the powered winch, which has helped control these problems. Electrical calculations are provided covering signal transmission on the cableway and the application of ultrasonic sounding using the hydrometric cableway also is described. (See also W90-01795) (Rochester-PTT)
W90-01796

**FLOW MEASUREMENTS IN OPEN AND CLOSED CONDUITS OF GRAVITATIONAL URBAN STORM SEWER NETWORKS.**
Vizgazdalkodasi Tudomanyos Kutato Intezet, Budapest (Hungary).
A. Borzsonyi.
IN: Advances in Hydrometry: Proceedings of a symposium held during the First Scientific Assembly of the International Association of Hydrological Sciences at Exeter, U.K., 19-30 July 1982. International Association of Hydrological Sciences Publication 134. 1982. p 19-23, 2 fig, 2 ref.

Descriptors: *Instrumentation, *Urban hydrology, *Gaging, *Gages, *Hungary, *Flow discharge, *Design criteria, *Measuring instruments, Data acquisition, Computers, Telemetry, Water level, Performance evaluation, Pressure head, Sewers.

The analytical investigation of unsteady flow phenomena in gravitational urban sewer networks is essential for proper dimensioning, hydraulic analysis, and operation of the network. Regular records of measurement data form the basis of such investigations. The construction and functions of a computer-based automatic data collection system installed along a selected section of the storm sewer network at Pecs in South Hungary are described. The system involves the telemetry of water levels, pressure heads, and flow rates at specific points of network, as well as of precipitation at six points in the basin. A structure of special design involving lateral constriction has been developed for the measurement of levels, heads, and flow rates. The structure is equally suited to measurement in both open and closed conduits. Provisions had to be made for passing sediments and solid pollutants as well. For measuring flow in open and closed conduits the data are computer-processed on the basis of calibrated rating curves. In free, open flow and in flow under pressure, the meter operates with an accuracy better than +or-5%. In submerged open flow the accuracy is estimated at +or-8%. (See also W90-01795) (Author's abstract)
W90-01797

**CURRENT METER CALIBRATION: INDIVIDUAL RATING VERSUS GROUP RATING.**
Department of the Environment, Reading (England). Water Data Unit.
R. W. Herschy.
IN: Advances in Hydrometry: Proceedings of a symposium held during the First Scientific Assembly of the International Association of Hydrological Sciences at Exeter, U.K., 19-30 July 1982. International Association of Hydrological Sciences Publication 134. 1982. p 25-31, 3 tab, 10 ref, 3 append.

Descriptors: *Instrumentation, *Gaging, *Stream gages, *Current meters, *Costs, Calibrations, United Kingdom, Standards, Accuracy.

The cost of the individual rating of current meters is high and is likely to increase substantially in the future. Both International and British Standards make provisions for current meters to be used with either an individual rating or a group rating. Current practices of individual rating and group rating (standard rating, average rating) are described; the investigations of Lambie, Smoot and Carter, and Grindley are described and some of their results are presented; and recent results of group calibrations are presented and accuracy of current meter gaugings is discussed. The evidence to date appears to support the view that the adoption of group ratings would not lead to any deterioration in the overall accuracy of normal current meter measurements and would undoubtedly significantly reduce the overall cost of ratings. Moreover, the cost of ratings is expected to increase substantially in the United Kingdom in 1982. However, strict control of manufacturer's tolerances would be an essential requirement for the implementation of group rating and, although these are explicitly stated in the Standards, careful vigilance by the user would be necessary. Of fundamental importance, however, is the care and attention of the current meter; where this is not up to the highest standard, neither an individual rating nor a group rating will give acceptable results. (See also W90-01795) (Rochester-PTT)
W90-01798

**UP-DATING OF DISCHARGE RATING CURVES BY MEANS OF MATHEMATICAL MODELS.**
Institut fuer Wasserwirtschaft, Berlin (German D.R.).
A. Becker, M. Melcher, and G. Kose.
IN: Advances in Hydrometry: Proceedings of a

symposium held during the First Scientific Assembly of the International Association of Hydrological Sciences at Exeter, U.K., 19-30 July 1982. International Association of Hydrological Sciences Publication 134. 1982. p 37-48, 4 fig, 8 ref.

Descriptors: *Model studies, *Stream gages, *Discharge measurement, *Mathematical models, *Gaging stations, Elbe River, Rating curves, East Germany, Errors, Data processing, Mountain streams, Lowland rivers.

An appropriate combination of precise flow measurements at selected well-established river gauging stations with flow computations along the river by means of mathematical models (streamflow routing techniques) can help considerably: (1) to monitor and update discharge rating curves at all gauging stations along the river; (2) to extrapolate the results of precise flow measurements performed at one or a few selected stations, (e.g., under critical flow conditions) to neighboring stations; and (3) to avoid water balance discrepancies along the river. A generalized technique has been developed in connection with the establishment and continuous operation of a real-time streamflow forecasting system for the River Elbe in the German Democratic Republic. The components and operation of this system is described and an approach for detection and correction of rating curve areas is discussed. The approach to the detection and correction of rating curve errors includes: (1) continuous visual inspection of the results of the daily computations (hydrographs); (2) determination of the deviations between computed and observed discharges after correction for traveltime errors in the computation; (3) careful analysis of deviation curves covering longer periods (several months or more) to identify typical counterpart forms as found at stations 7 and 9 on the River Elbe; (4) implementation of check computations over longer river reaches, by-passing those stations where rating curve errors are suspected (using computed rather than observed discharges); (5) implementation of streamflow measurements in the flow ranges of interest; and (6) updating of the rating curves according to the derived representative deviation curves. This approach has proved very useful on the Elbe river system and a similar approach may be applicable to many large rivers, particularly for the downstream reaches of mountain rivers, where the time variation of the intermediate inflows from ungauged sub-basins is significantly slower than that of the streamflow. (See also W90-01795) (Rochester-PTT)
W90-01799

**METHOD OF UNIFORMIZING THE STAGE-DISCHARGE RELATIONS OF STABLE RIVER BEDS AND ITS APPLICATION.**
Yangtze Valley Planning Office, Wuhan (China). Hydrology Dept.
W.-Y. Ge, X.-Q. Luo, and P.-W. Tang.
IN: Advances in Hydrometry: Proceedings of a symposium held during the First Scientific Assembly of the International Association of Hydrological Sciences at Exeter, U.K., 19-30 July 1982. International Association of Hydrological Sciences Publication 134. 1982. p 49-61, 1 fig, 4 tab.

Descriptors: *Stage-discharge relations, *Stream gages, *Gaging stations, *Hydrometry, Network design, Uniformization, Data acquisition, Data processing, Flow discharge, Automation.

With the advent of wide use of electronic computers in hydrometry, many methods and practices have been introduced for uniformizing the stage-discharge relation. However, many gauging stations are subjected to rapidly changing stage. The stage-discharge relation is very complicated and is not a simple curve. The measurements scatter about the rating curve, up and down, forming various loops. To determine these ratings requires many measurements during flood periods, complicating generalization, standardization, and automation. The fundamental principle of uniformization is defined and mathematical models of uniformization are discussed, including the parabolic optimum model, the hyperbolic simulation model, the multivariate linear stepwise regression optimum model, and the power function linear stepwise regression optimum model. Practical aspects of uniformization are considered, including selection of a reference gauge, application of uniformization in hydrometric data processing, and the application of uniformization to hydrometry. Uniformizing the complex rating curve of stable river beds gives a clear conception, provides a simple and appropriate adjustment method, and uses this method as a basis for solving the principal problems of automatic processing. However, uniformizing the rating curve is valuable beyond its role in automatic processing. The method provides a basis for reducing the number of measurements and makes continuous-record stations obsolete, or changes them to partial-record stations where data can be obtained at yearly intervals. Uniformization makes possible the improvement of discharge measurement and allows gauging stations to be visited only periodically. It also provides a new way of simplifying the complex loop rating for hydrological design and forecasting. (See also W9-01795) (Rochester-PTT)
W90-01800

**EQUATIONS FOR ESTIMATING DISCHARGE IN STEEP CHANNELS WITH COARSE BED MATERIAL.**
Institute of Hydrology, Wallingford (England).
J. C. Bathurst.
IN: Advances in Hydrometry: Proceedings of a symposium held during the First Scientific Assembly of the International Association of Hydrological Sciences at Exeter, U.K., 19-30 July 1982. International Association of Hydrological Sciences Publication 134. 1982. p 63-71, 5 tab, 10 ref.

Descriptors: *Stage-discharge relations, *Flow discharge, *Stream gages, Conveyance equations, Mathematical equations, Slopes, Hydrometry, Yemen, Bed-load discharge, Errors.

The use of process-based conveyance equations for estimating discharge in steep channels with coarse bed material is discussed. As the hydraulic characteristics of such channels often preclude direct gauging techniques, it is necessary to use the indirect slope-area method. In this method, the peak discharges are calculated as functions of channel slope and conveyance, the latter being a function of channel cross-sectional shape and bed material size. Previous application has been hampered by a lack of knowledge concerning flow processes in steep channels, but with the equations now available, variations of conveyance with depth, bed material size, and sediment movement can be estimated. Using data from the Yemen Arab Republic, it is shown that discharge predictions by these equations have an accuracy of about 10% for low flows and are of the correct order of magnitude at flood flow. The test results in the present study agree with the few other field results available. The accuracy depends on the satisfaction of the assumptions behind the equations, particularly that the measurement site not be affected by ponding. It also is important, where sand is present, to note whether or not the coarse bed material is dominating the conditions. Also, errors may result from the use of equations (designed for steady flows) in unsteady conditions, for example, at flood peaks. (See also W90-01795) (Rochester-PTT)
W90-01801

**MULTILAYER WIDTH-INTEGRATED VELOCITY MEASUREMENT METHOD.**
Fujian Provincial Hydrometric Station, Fuzhou (China).
R.-H. Chen.
IN: Advances in Hydrometry: Proceedings of a symposium held during the First Scientific Assembly of the International Association of Hydrological Sciences at Exeter, U.K., 19-30 July 1982. International Association of Hydrological Sciences Publication 134. 1982. p 75-85, 3 fig, 2 tab.

Descriptors: *Stream gages, *Instrumentation, *Current meters, *Measuring instruments, *Discharge measurement, *Average velocity, Cost analysis, China, Performance evaluation, Field tests.

The multilayer width-integrated velocity measurement method (MWIVMM) is an innovation in current meter design. The cross section of the river is divided into 4 or 5 layers: the meter (which is suspended from a cable) is drawn across each layer at a constant rate while it makes continuous width-integrated velocity measurements. This contrasts with the standard method in which velocities are determined at fixed points along a series of verticals. The MWIVMM has the advantage of measuring the mean velocity of each individual layer of the cross section. Because the operation saves about two-thirds of the time needed for the standard method, it may prove attractive, particularly on rivers with rapidly changing stage. The Fujian Experimental Station (Wen Shan Li Experimental Station) has tested the method on 41 occasions. Deviations from the traditional method were in the range -5.9 to +6.1%. (See also W90-01795) (Author's abstract)
W90-01802

**MOVING BOAT DISCHARGE MEASUREMENTS USING ACOUSTIC DOPPLER TECHNIQUES.**
Geological Survey, NSTL Station, MS. Gulf Coast Hydroscience Center.
V. R. Schneider, and R. H. Billings.
IN: Advances in Hydrometry: Proceedings of a symposium held during the First Scientific Assembly of the International Association of Hydrological Sciences at Exeter, U.K., 19-30 July 1982. International Association of Hydrological Sciences Publication 134. 1982. p 87-92, 5 ref.

Descriptors: *Stream gages, *Instrumentation, *Boats, *Discharge measurement, *Moving-boat method, *Current meters, Field tests, Doppler technology, Acoustic sensors, Mississippi River, Louisiana, Feasibility studies, Cost analysis, Performance evaluation.

Moving-boat techniques using conventional equipment have been tested and established. Discharge is computed on the basis of cross-section geometry, current meter readings, and flow angles relative to shore-based targets. Recent developments in acoustic Doppler technology promise a new and potentially superior approach. The acoustic system uses a single transducer array to probe the water column beneath a moving boat and processes echoes from the water mass and bottom into sectional area and velocity measurements. Total discharge across a straight line between the starting and ending points of the boat travel is computed by integration. Feasibility tests are being conducted in the Mississippi River near Baton Rouge, Louisiana, where depths are in range 30-50 m. Discharge measurements will be independently made with current meter, conventional moving boat, and acoustic Doppler techniques. Although it is anticipated that significant development would be required to produce an operational system, and that the final cost could be in the range of $20,000-25,000 per unit, the system has several benefits: (1) use with little prior site reconnaissance and in non-uniform conditions, (2) minimal manpower requirements, (3) immediate availability of results, and (4) ease of operation and durability of equipment. (See also W90-01795) (Author's abstract)
W90-01803

**DEVELOPMENTS IN HYDROMETRY IN INDIA.**
Central Water Commission, New Delhi (India).
S. K. Haldar.
IN: Advances in Hydrometry: Proceedings of a symposium held during the First Scientific Assembly of the International Association of Hydrological Sciences at Exeter, U.K., 19-30 July 1982. International Association of Hydrological Sciences Publication 134. 1982. p 93-100, 4 fig, 1 tab.

Descriptors: *Instrumentation, *Flood peak, *Hydrometry, *India, *Discharge measurement, *Flood discharge, Hydrographs, Mathematical equations, River Yamuna, Current meters, Moving-boat method, Performance evaluation.

Measurement of high flood discharge is a specialized technique requiring a great deal of courage, skill, and experience. Some Indian rivers experi-

ence very high peak discharges, amounting to more than 60,000 cu m/sec when in flood. Physical features of the channel, which govern the stage discharge relation, can change suddenly during high flood and make it difficult to establish and use a unique stage-discharge relation. Current meter discharge measurements may be conducted daily, even during high flood to establish the discharge hydrograph. Calculating high flood discharges based on current meter readings is described using the conventional method and the moving-boat method, and the two are compared. In the case of the measurements obtained in the River Yamuna, the moving-boat method yielded discharge measurements differing from those of the conventional method by -10.34 to +6.76%. Indirect peak discharge estimation usually is carried out by the slope-area method. The discharge is computed on the basis of the uniform flow equation of either Chezy or Manning. A good deal of judgment is required for the use of the indirect method because of the effect estimates of the roughness coefficient (n) and the cross-sectional area has on the discharge estimate. Discharge measurements by the moving-boat method are conducted at some of the important sites during flood periods and experience has shown that this method is both quick and reliable. (See also W90-01795) (Rochester-PTT)
W90-01804

**DESIGN AND STUDY OF THE INSTRUMENTATION REQUIRED FOR THE MEASUREMENT OF DISCHARGE BY THE MOVING BOAT METHOD.**
Water Conservancy Hydroelectric Power Scientific Research Inst., Beijing (China).
H. L. Wang.
IN: Advances in Hydrometry: Proceedings of a symposium held during the First Scientific Assembly of the International Association of Hydrological Sciences at Exeter, U.K., 19-30 July 1982. International Association of Hydrological Sciences Publication 134. 1982. p 101-108, 3 fig, append.

Descriptors: *Instrumentation, *Stream gages, *Discharge measurement, *Boats, *Current meters, *Moving-boat method, *Standards, Measuring instruments, China, Design criteria, Discharge measurement.

The instruments and equipment developed in China for the measurement of river discharge by the moving-boat method are described and compared with those in ISO-4369, the standard for this procedure. The basic equipment consists of a propeller-type current meter with a photoelectric velocity sensor generating 24 pulse signals per revolution, an angle indicator with magnetic synchronous inductor, and an improved echo sounder. The remaining instrumentation is automatic, and includes simultaneous operation and synchronous recording. Drawings are provided of the LS25-1-24 propeller-type current meter with 24 signals/revolution and the turning shaft support angle indicator. The logic of the counting circuits is explained, including a block diagram for the instrument for measurement of discharge using the moving-boat method. Measuring discharge with the moving-boat method is simple, but its calculation from the data obtained is complicated. A planned enhancement of the instrument is a microprocessor to perform the calculations so that readings will be directly in discharge units. (See also W90-01795) (Rochester-PTT)
W90-01805

**SAHELIAN HYDROMETRY: CURRENT TECHNIQUE AND PERSPECTIVES OF DEVELOPMENT (L'HYDROMETRIE AU SAHEL: TECHNIQUE ACTUELLE ET PERSPECTIVES DE DEVELOPPEMENT).**
Agrhymet Centre, Niamey (Niger).
A. Musy.
IN: Advances in Hydrometry: Proceedings of a symposium held during the First Scientific Assembly of the International Association of Hydrological Sciences at Exeter, U.K., 19-30 July 1982. International Association of Hydrological Sciences Publication 134. 1982. p 109-115. English summary.

Descriptors: *Instrumentation, *Africa, *Sahel, *Hydrometry, *Tropical regions, Developing countries, Discharge measurement, Performance evaluation, Reviews.

Climatic conditions and topographic and socio-economic conditions existing in Sahelian countries (Africa) very much influence the choice of equipment and methods of data analysis appropriate for the determination of hydraulic potential of these regions. The existing conditions hardly encourage the introduction of new hydrometric techniques. It is vital that technology of measuring water levels and discharges should be suited to the demanding conditions of use in difficult circumstances and adapted to the technical and financial limitations of the region. The commonly encountered equipment and techniques of hydrometry in Sahelian countries are reviewed, and aspects related to the development of hydrometry in these regions are discussed. (See also W90-01795) (Author's abstract)
W90-01806

**FLOOD FLOW GAUGING WITH TRITIUM IN SOUTHERN AFRICA.**
Ministry of Water Development, Salisbury (Zimbabwe). Hydrological Branch.
P. Wurzel, and P. R. B. Ward.
IN: Advances in Hydrometry: Proceedings of a symposium held during the First Scientific Assembly of the International Association of Hydrological Sciences at Exeter, U.K., 19-30 July 1982. International Association of Hydrological Sciences Publication 134. 1982. p 119-128, 3 fig, 2 tab, 11 ref.

Descriptors: *Tracers, *Discharge measurement, *Stream gages, *Zimbabwe, *Flood discharge, *Monsoons, *Tritium, *Isotopic tracers, Performance evaluation, Ephemeral streams, Comparison studies, Mathematical equations, Remote sensing.

Tritiated water has been used routinely for a number of years in Zimbabwe for measuring flood flows by the dilution method. The advantages of using the dilution method instead of current meter gaugings in ephemeral rivers with difficult access are described. The cost advantage of using tritiated water over tracers such as Rhodamine WT is listed, and details of the injection and sampling procedures are illustrated. Experience with the method shows that approximate rules of thumb for forecasting tracer arrival times and tracer transit durations are useful in planning the execution of the measurements. Ward's equation is used to compute mixing distances and gives good approximate predictions of desirable injection point-to-sampling point distances. The reliability, low cost, and general simplicity of the dilution method using tritium as a tracer for flood gaugings has been demonstrated. At present, the most difficult aspect of any flood flow gauging in tropical monsoon climates is to ensure that the gauging team is on site before the flood has passed. Although radar is used to identify cumulonimbus cloud masses in flood gauging-warning procedure, one out of two flood events have been missed. Rapidly rising and falling floods and long travel distances are major problems. (See also W90-01795) (Rochester-PTT)
W90-01807

**TRACER MEASUREMENTS IN LOWLAND RIVERS.**
Vrije Univ., Brussels (Belgium). Lab. of Hydrology.
W. Bauwens, J. Bellon, and A. Van der Beken.
IN: Advances in Hydrometry: Proceedings of a symposium held during the First Scientific Assembly of the International Association of Hydrological Sciences at Exeter, U.K., 19-30 July 1982. International Association of Hydrological Sciences Publication 134. 1982. p 129-139, 5 fig, 2 tab, 12 ref.

Descriptors: *Discharge measurement, *Belgium, *Tracers, *Traveltime, *Dye releases, Adsorption, Organic matter, River sediments, Rhodamine dyes, Mathematical equations, River Voer, River Dijle, River Scheldt.

Comparative travel time measurements were carried out in the River Voer, Belgium, to study the influence of adsorption of fluorescent tracers by alluvial sediment and organic material on the travel time determination. Rhodamine B, rhodamine WT, and sulfo-rhodamine B were used. It was demonstrated that adsorption can influence the travel time derived from the concentration curve, especially if the centroid of this curve is used. The relationship between discharge and velocity was examined in a study conducted in the River Dijle, a tributary of the River Scheldt, also in Belgium. Travel time measurements conducted at discharges of about 5, 7, 18, and 26 cu m/sec showed that velocity tends toward a limit (between 0.8 and 0.9 m/sec) with increasing discharge. Measured and calculated values of satisfactory dispersion coefficients are compared. Satisfactory predictions of this coefficient can be calculated from Fischer's equation or Liu's equation. (See also W90-01795) (Rochester-PTT)
W90-01808

**TWO LESS CONVENTIONAL METHODS OF FLOW-GAUGING.**
Leicester Univ. (England). Dept. of Engineering.
P. H. John, F. A. Johnson, and P. Sutcliffe.
IN: Advances in Hydrometry: Proceedings of a symposium held during the First Scientific Assembly of the International Association of Hydrological Sciences at Exeter, U.K., 19-30 July 1982. International Association of Hydrological Sciences Publication 134. 1982. p 141-152, 2 fig, 2 tab, 22 ref.

Descriptors: *Instrumentation, *Stream gages, *Discharge measurement, Field tests, Salt-velocity methods, Bubble gages, Conductivity, Flowmeters, Performance evaluation, Measuring instruments, Automation.

The recent development of the integrating float and salt-velocity methods of flow-gauging is discussed. The results of tests relating to precalibration of plastic floats and of field trials using both the single and two-float techniques are presented. It is concluded that, if solid floats are used, precalibration may be employed with confidence, because integrating float gaugings compare favorably with those obtained by current meter. The use of air bubbles as floats also was examined. This method has considerable potential but needs further investigation. Two new automated forms of the salt-velocity technique (the Conductivity Flow Meter and an electronic method) are described and the results of laboratory tests are presented. The C.F.M. method was compared with Young and Wilson's manual trace analysis and a current meter. The C.F.M. method could offer distinct advantages over a current meter in both open channel and pipe flow containing suspended material, where the current meter is notoriously inefficient. The electronic method uses two conductivity cells, one at each sampling station, connected by an alternating current bridge. The output from the bridge is interfaced with a simple logic system using an I.C. Schmitt trigger. The results of this device in a 25-mm bore pipe were compared with volumetric measurements. It appears that the accuracy is with +or-2% for velocities from 0.1 to 1.5 m/sec, and that precision is high, at least in pipe flows. Although slightly less accurate than some other salt-velocity techniques, the automated methods have the advantage of being portable and giving velocity data quickly. (See also W90-01795) (Rochester-PTT)
W90-01809

**RISING AIR FLOAT TECHNIQUE FOR THE MEASUREMENT OF STREAM DISCHARGE.**
Lancaster Univ. (England). Dept. of Environmental Sciences.
D. M. Sargent.
IN: Advances in Hydrometry: Proceedings of a symposium held during the First Scientific Assembly of the International Association of Hydrological Sciences at Exeter, U.K., 19-30 July 1982. International Association of Hydrological Sciences Publication 134. 1982. p 153-164, 3 fig, 1 tab, 4 ref.

Descriptors: *Instrumentation, *Stream gages, *Bubble gages, *Discharge measurement, Field

tests, Performance evaluation, Photography, Velocity curve, Comparison studies, Velocity-area method.

The development is described of a simple, practical method of stream flow measurement based on the integrated float technique using air bubbles as rising integrating floats. The field equipment, consisting of a flexible rubber air supply pipe fitted with nozzles, is described along with the photographic method of data capture for subsequent analysis using a microcomputer. Field use and a number of field applications including rivers of 20 m to 100 m in width, slow-moving canals, and concrete channels are described. Current work on the possibility of automation using television cameras is described. Advantages of the air bubble technique include an instantaneous measurement of flow rate, reduction of field and processing time, measurement of velocities at the threshold of current meter movement, no need to measure the stream channel cross-section profile, no need for as stable stage/discharge relationship, no need for removal of moderate weed growth before use, and the possibility of night gaugings. Limitations include the need for a relatively quiet and unbroken water surface, time required for film development, and the fact that measurements are of discharge per unit width, with no measurement of velocity produced, and the need to make multiple photographs on rivers wider than 50 m, thus eliminating the truly instantaneous discharge result. It is concluded that the technique offers a real alternative to the velocity-area method, particularly because it produces measurements of instantaneous discharge and can be used in some situations where gauging is not possible using traditional techniques. (See also W89-01795) (Rochester-PTT)
W90-01810

**INSTALLATION AND OPERATION OF A BUBBLE GAUGE NETWORK IN THE MAHAKAM RIVER BASIN, EAST KALIMANTAN, INDONESIA.**
German Agency for Technical Cooperation, Frankfurt am Main (Germany, F.R.).
T. N. Woods, and E. Wachan.
IN: Advances in Hydrometry: Proceedings of a symposium held during the First Scientific Assembly of the International Association of Hydrological Sciences at Exeter, U.K., 19-30 July 1982. International Association of Hydrological Sciences Publication 134. 1982. p 165-172, 3 fig, 4 ref.

Descriptors: *Instrumentation, *Indonesia, *Stream gages, *Water level, *Bubble gages, *Discharge measurement, Mahakam River Basin, Network design, Developing countries, Performance evaluation.

A network of automatic water level recording stations has been installed in the Mahakam River Basin, Indonesia (ca. 67,000 sq km) to provide water resources data for planning of transmigration (resettlement) and area development programs and to monitor the environmental problems of flooding, erosion, and sedimentation associated with large scale clearing of primary forest. The topography and instability of the river sections led to the selection of bubble gauge recorders and the use of pile timber supports for staff gauges at 13 locations. The bubble gauge recorder is described, including modifications made to simplify its operation, station construction, instrument installation, and management of the network in an area where rivers are the only practical means of communication. The instrument was required to record stage variations of 15 m with an accuracy of +or-1 cm. The SEBA Bubble Gauge Omega was selected. The standard strip chart recorder was replaced by a horizontal drum recorder. The instrument house was constructed of wood and mounted on stilts on the top of the bank. Three different types of staff gauge installations were implemented because of the variable stability of the river banks. In the absence of a mains supply, 6-volt D.C. batteries were used to power the instrument; compressed air was used as the operating gas. By modification of the instrument, the application of practical installation techniques, and staff training programs, a relatively complex instrument network is working satisfactorily under remote conditions. (See also W90-01795) (Rochester-PTT)
W90-01811

**DETERMINATION OF THE ACCURACY OF WATER LEVEL OBSERVATIONS.**
Rijkswaterstaat, The Hague (Netherlands).
J. W. van der Made.
IN: Advances in Hydrometry: Proceedings of a symposium held during the First Scientific Assembly of the International Association of Hydrological Sciences at Exeter, U.K., 19-30 July 1982. International Association of Hydrological Sciences Publication 134. 1982. p 173-184, 12 fig.

Descriptors: *Instrumentation, *Water level recorders, *Quality control, *Measuring instruments, Regression analysis, Gages, Standard deviation, Mathematical analysis, Errors, IJssel River, Statistical analysis.

The accuracy of water level observation, expressed by its standard deviation, is influenced not only by the recording instrument itself by also by the situation and the conditions at and around the station. The standard deviation can be derived from local observations only, because of the real movements of the water stage, i.e, the phenomena being observed (signal). Methods of deriving the standard deviation (inaccuracy) from neighboring stations using simple and multiple regression are discussed. From these results it appears that the standard deviation of water level observations in rivers can amount to several centimeters. Studies were conducted on the River IJssel (The Netherlands). With simple regression, the local standard deviations were in the range 1.37-2.57 cm (3 stations), whereas with multiple linear regressions, the local standard deviations at the same 3 stations were in the range 1.40-2.27 cm. The local standard deviation values can be used in network design. A network in The Netherlands designed on the basis of a local standard deviation value of 2.5 cm has yielded acceptable results from the water level gaging network. (See also W90-01795) (Rochester-PTT)
W90-01812

**IMPROVEMENT OF ULTRASONIC FLOWMETER IN RIVERS IN JAPAN.**
National Research Center for Disaster Prevention, Sakura (Japan).
T. Kinosita.
IN: Advances in Hydrometry: Proceedings of a symposium held during the First Scientific Assembly of the International Association of Hydrological Sciences at Exeter, U.K., 19-30 July 1982. International Association of Hydrological Sciences Publication 134. 1982. p 187-202, 12 fig, 6 ref.

Descriptors: *Instrumentation, *Japan, *Flowmeters, *Ultrasonics, *Discharge measurement, Current meters, Drift rods, Floods, Tidal rivers, Outlets, Performance evaluation, Hydrometry.

When using ultrasonic flow meters, missing data and other problems are experienced. The causes of these problems were studied and are reported here, along with a discussion of the principles of ultrasonic flow metering. Ultrasonic methods are compared with traditional methods of gauging (current meter and drift rod); discharge calculations are explained; and the following examples of gauging situations are presented: high water, tidal rivers, and outflow from a lake. Problems still needing work are the need for a cable crossing, temperature effects causing loss of data, noise damage to the ultrasonic instrument, and changes in ultrasonic velocity. It is concluded that ultrasonic flow meters have been greatly improved in recent years and are fully operational today, especially at gauging sites were a stage-discharge curve is not available or for water management in a tidal river. Wide application of the ultrasonic method in hydrometric networks is recommended. (See also W90-01795) (Rochester-PTT)
W90-01813

**EXPERIENCES GAINED DURING THE HYDRAULIC INVESTIGATIONS ON THE COOLING WATER SYSTEM OF A THERMAL POWER STATION.**
Vizgazdalkodasi Tudomanyos Kutato Intezet, Budapest (Hungary).
J. Tas, and P. Schneemeier.
IN: Advances in Hydrometry: Proceedings of a symposium held during the First Scientific Assembly of the International Association of Hydrological Sciences at Exeter, U.K., 19-30 July 1982. International Association of Hydrological Sciences Publication 134. 1982. p 203-213, 5 fig, 1 tab.

Descriptors: *Instrumentation, *Cooling water, *Hydraulics, *Discharge measurement, *Ultrasonics, Current meters, Comparison studies, Performance evaluation, Hungary, Thermal powerplants, Hydraulic models.

Occasional flow measurements with conventional current meters often are too time-consuming and labor-consuming to be practicable for field investigations on the water systems of large industrial and agricultural consumers. Measurements under conditions of extreme departure from normal are especially difficult. In such cases the ultrasonic method of flow measurement can be applied to advantage and with acceptable accuracy. Several measurements needed to be taken at water-cooled power plants in Hungary, but with adaptation to the progress of construction of the power plants. Flow measurements by current meter and those obtained by ultrasound at one of these power plants are described and compared. For a pump investigated by current meter and ultrasonic flow measurement, both methods yielded a highest efficiency of 91.1% compared with the guaranteed value of 88.0%. The other parameters of the pumps were measured by the same method and even using the same instruments. Fair agreement between the two methods was obtained in measuring the differential pressure head of suction pipes in experiments in which current meter measurements obtained with one pump were compared with ultrasonic measurements obtained on three other pumps and with measuring weir measurements made on a 1:17.5 scale model. From the experience gained during measurements at this power station, it is concluded that the ultrasonic method can be used to advantage in all field investigations where the requirements of measurement must be subordinated to the interests of operation and where the measurements must be carried out in the shortest possible time. (See also W90-01795) (Rochester-PTT)
W90-01814

**MEASUREMENT OF OPEN CHANNEL FLOW BY THE ELECTROMAGNETIC GAUGE.**
Department of the Environment, Reading (England). Water Data Unit.
R. W. Herschy, and J. D. Newman.
IN: Advances in Hydrometry: Proceedings of a symposium held during the First Scientific Assembly of the International Association of Hydrological Sciences at Exeter, U.K., 19-30 July 1982. International Association of Hydrological Sciences Publication 134. 1982. p 215-227, 10 fig, 1 tab, 4 ref.

Descriptors: *Instrumentation, *Discharge measurement, *Open-channel flow, *Stream gages, *Pipe flow, *Electromagnetic gages, Sewers, Culverts, Measuring instruments, Performance evaluation.

Since 1975 significant improvements have been made in the electromagnetic gauge for measuring flow in open channels. These improvements, which have been mainly in the instrumentation, are described together with a summary of the principle of operation, site requirements, and applications of the electromagnetic gauge. Application of the gauge to the measurement of flow in sewers and culverts also is presented. The electromagnetic gauge is made up of five major elements: (1) an cable coil which serves and electromagnet to create a magnetic field across the channel; (2) electrodes to sense the potential difference between opposite sides of the channel that is created by the flow of water; (3) an electrically insulating membrane lining the bed to prevent shorting of the generated signal; (4) a water level sensor; and (5) instrumentation for measuring supplying current to the coil, measuring the electrode potential, accept-

ing the water gauge signal, and combining electrode potential, depth, and site geometry to indicate discharge. There are numerous site requirements for an electromagnetic gauging site and each site must be calibrated. With improved instrumentation, the technique is now applicable to rivers up to about 25 m wide and in partly-filled pipes with very low velocities. The technique covers a very large dynamic range, from dry weather flow to a surcharge condition in pipes, and it also will measure reverse flow. The technique is suitable for operation in pipes carrying a considerable load. High accuracy and reliability have been achieved at a number of sites. (See also W90-01795) (Rochester-PTT)
W90-01815

**HYDROMETRIC DATA CAPTURE USING INTELLIGENT SOLID STATE LOGGING SYSTEMS.**
Severn-Trent Water Authority, Birmingham (England).
For primary bibliographic entry see Field 7A.
W90-01816

**FLOW MEASUREMENT AT SEWAGE TREATMENT PLANTS.**
Vizgazdalkodasi Tudomanyos Kutato Intezet, Budapest (Hungary). Inst. for Hydraulic Engineering.
I. Mayer.
IN: Advances in Hydrometry: Proceedings of a symposium held during the First Scientific Assembly of the International Association of Hydrological Sciences at Exeter, U.K., 19-30 July 1982. International Association of Hydrological Sciences Publication 134. 1982. p 241-245, 3 fig.

Descriptors: *Instrumentation, *Flowmeters, *Wastewater facilities, *Discharge measurement, Performance evaluation, Data acquisition, Automation, Deterioration, Corrosion, Water level, Hydrometry.

Flow rates in open conduits are measured almost exclusively by devices registering the headwater level of shooting flow created by a constriction. At sewage treatment plants the sensing devices situated along the measuring constriction are susceptible to clogging, corrosion, and to becoming inoperative, owing to the chemical, bacterial, and radiation effects of the substances present in the water. These difficulties have been overcome by using a measuring tube that is continuously flushed with fresh water. This is substantially a perforated tube in which the flushing water flows towards the sewage. The surface of the flushing fresh water flows towards the sewage. The surface of the flushing fresh water in the tube rises (as in communicating vessels) to the same height as the surface of the sewage to be measured. In this way a freshwater measuring station is achieved in the sewage. A teflon-coated sensing device is installed at the measuring station. The signals transmitted are transformed by microprocessors and a calculator into digital and graphical printouts indicating the actual flow rate, and the total volume up to the time of measurement. (See also W90-01795) (Author's abstract)
W90-01817

**MONITORING WATER QUANTITY AND WATER QUALITY IN AN URBAN BASIN.**
Rijksdienst voor de Ijsselmeerpolders, Lelystad (Netherlands).
F. H. M. van de Ven.
IN: Advances in Hydrometry: Proceedings of a symposium held during the First Scientific Assembly of the International Association of Hydrological Sciences at Exeter, U.K., 19-30 July 1982. International Association of Hydrological Sciences Publication 134. 1982. p 247-256, 5 fig, 3 ref.

Descriptors: *Urban hydrology, *Instrumentation, *The Netherlands, *Urban areas, *Monitoring, *Discharge measurement, *Water quality, *Data acquisition, Sampling.

A new urban drainage basin in Lelystad (The Netherlands) has been equipped for monitoring both water quality and water quantity at an experimental basin of 45,340 sq m. Measurements of flow and the water quality parameters are performed continuously at the outfall of the stormwater drain and at three points in the receiving water body--a canal. A sampler is installed at the outfall. The monitoring equipment is connected to a computer-controlled data logging system by a common carrier interface. On-line data reduction is performed by the logger, while the sampler takes either grab samples or collect samples. The quantitative variables are measured using two instruments simultaneously for a higher degree of reliability and accuracy. The qualitative monitors are regularly recalibrated and are kept under a strict preventive maintenance schedule. (See also W90-01795) (Author's abstract)
W90-01818

**HADDINGTON FLOOD WARNING SYSTEM.**
Institute of Hydrology, Wallingford (England).
G. P. Brunsdon, and R. J. Sargent.
IN: Advances in Hydrometry: Proceedings of a symposium held during the First Scientific Assembly of the International Association of Hydrological Sciences at Exeter, U.K., 19-30 July 1982. International Association of Hydrological Sciences Publication 134. 1982. p 257-272, 5 fig.

Descriptors: *Flood warning, *Scotland, *Flood forecasting, *Watershed management, *Data acquisition, *Warning systems, Isolated Event Model, Rainfall-runoff relationships, Hydrologic models, Rain gages, Measuring instruments, Haddington Basin, Performance evaluation, Monitoring.

A data acquisition system is described that is designed to forecast floods in the Haddington region, 25 km east of Edinburgh, Scotland. The scheme was designed to produce the data necessary to operate a rainfall/runoff model developed especially for the catchment. The model incorporated in the system is an adaptation of the Isolated Event Model; the model involves only four parameters, which were determined using historical data on flood events on the River Tyne. A relationship was established between runoff percentage (ROP) and the flow in the river prior to the commencement of a storm (Qo). The best fit was obtained from a logarithmic relationship of the form: ROP = a + b ln Qo. The system design includes a base station, outstations with tipping-bucket rain gauges and powered by solar panels and a 12-volt D.C. battery, and a monitor station. The instrumentation is compact, simple to operate, exploits modern technology, and is fully automatic. Low cost, good reliability, and minimal maintenance requirements were factors considered during design. The system collects river flow and rainfall data, computes the catchment's response using rainfall/runoff model and automatically updates the remote monitor with flow predictions and maintenance alerts. It is particularly suited to flood warning schemes where 24-hour manning cannot be provided and is specifically designed to operate on steep catchments where upstream river correlation cannot give sufficient warning. (See also W90-01795) (Rochester-PTT)
W90-01819

**SATELLITE DATA AS A BASIS FOR THE ESTIMATION OF RAINFALL AND RUNOFF.**
Ruhr Univ., Bochum (Germany, F.R.).
L. R. Kruger, G. Strubing, and G. A. Schultz.
IN: Advances in Hydrometry: Proceedings of a symposium held during the First Scientific Assembly of the International Association of Hydrological Sciences at Exeter, U.K., 19-30 July 1982. International Association of Hydrological Sciences Publication 134. 1982. p 273-284, 10 fig, 7 ref.

Descriptors: *Telemetry, *Instrumentation, *Remote sensing, *Data acquisition, *Satellite technology, *Rainfall-runoff relationships, Infrared imagery, Developing countries.

Remote sensing techniques are increasingly applied in acquiring hydrological data. Particularly in developing countries (where hydrometric data often are not available) remote sensing techniques based on satellite imagery may be valuable for design or operation of water resources systems. Two techniques for the application of satellite imagery in hydrology are presented. The first is a method for the estimation of rainfall volumes from infrared imagery of a geostationary satellite providing information of the time-dependent change of cloud surface temperature and cloud area. On the basis of these parameters a mathematical model has been developed that computes rainfall volumes. This technique is not yet operational, but in principle it can be used for runoff estimation. The second technique is a method of runoff estimation from images of a polar orbiting satellite in which an indexing technique is employed. The method allows direct estimation of monthly runoff values from daily infrared images. The method eventually could be applied for the generation of hydrologic design data. (See also W90-01795) (Author's abstract)
W90-01820

**TOWARDS A SATELLITE-BASED HYDROMETRIC DATA COLLECTION SYSTEM.**
Department of the Environment, Reading (England). Water Data Unit.
R. W. Herschy.
IN: Advances in Hydrometry: Proceedings of a symposium held during the First Scientific Assembly of the International Association of Hydrological Sciences at Exeter, U.K., 19-30 July 1982. International Association of Hydrological Sciences Publication 134. 1982. p 285-296, 3 fig, 1 tab, 4 ref.

Descriptors: *Remote sensing, *Hydrometry, *Meterological data collection, *United Kingdom, *Satellite technology, *Telemetry, *Data acquisition, Weather facsimile system, METEOSAT, Management planning.

Water level and discharge data for United Kingdom streams and rivers are at present recorded on punched paper tape. The system involves delay and the equipment is due for replacement. The use of satellite telemetry is being considered as an alternative. The types of Data Collecting Platforms (DCPs) available are described, together with the satellites (geostationary and polar orbiting) and earth receiving stations that make up the communication chain. Among the systems described are: sensors, weather facsimile (WEFAX) system, and existing telemetry systems. The problems and costs of changing to the new system, and the future advantages are outlined. A satellite data collection system making use of the METEOSAT WEFAX facility is proposed in which the data are retransmitted directly via the satellite to the user's operations center where they may be interfaced with the user's computer. It is anticipated that suitable satellites will continue to be available at least until the end of the century. (See also W90-01795) (Author's abstract)
W90-01821

**WARNING SYSTEM COMPATIBLE WITH RANDOMLY TIMED POLAR SATELLITES: DEVELOPMENT ALTERNATIVES FOR OIL SPILL WARNING SYSTEMS.**
Vizgazdalkodasi Tudomanyos Kutato Intezet, Budapest (Hungary).
L. Palos.
IN: Advances in Hydrometry: Proceedings of a symposium held during the First Scientific Assembly of the International Association of Hydrological Sciences at Exeter, U.K., 19-30 July 1982. International Association of Hydrological Sciences Publication 134. 1982. p 297-301.

Descriptors: *Remote sensing, *Oil spills, *Warning systems, *Danube River, Satellite technology, Data acquisition, Management planning, METEOSAT, ARGOS, Hungary, Performance evaluation, Comparison studies.

Investigations are being made in Hungary to find the most satisfactory way in which the Oil Spill Warning System (OSWS) can give rapid automatic warning on oil spills in the Danube Basin to those authorities that can take action. The sensors are placed on buoys, which at present communicate by line-of-sight radio with bank stations, and then via

telex or postal systems. There are two ways to increase the reliability of communications in these systems: (1) to build double routes to the bank stations and (2) to bypass the bank stations. The most obvious method of bypassing the bank stations is to use existing satellite repeaters of METEOSAT and ARGOS systems. The general features of these two systems are discussed here in relation to their possible role in the Hungarian OSWS. The ARGOS system has only one major disadvantage in the proposed use, but it is a serious one. The communication with the polar orbital satellites is possible only within restricted time slots. In the worst case this could lead to a delay of up to 4 hr in reporting an oil spill. The METEOSAT geostationary satellite link is continuously available. (See also W90-01795) (Rochester-PTT)
W90-01822

**DETERMINATION OF A MEASURING NETWORK ALONG RIVERS.**
Technische Hogeschool Delft (Netherlands). Dept. of Civil Engineering.
P. Van der Kloet, H. De Niet, and A. G. Posthumus.
IN: Advances in Hydrometry: Proceedings of a symposium held during the First Scientific Assembly of the International Association of Hydrological Sciences at Exeter, U.K., 19-30 July 1982. International Association of Hydrological Sciences Publication 134. 1982. p 305-319, 8 fig, 5 tab, 3 ref.

Descriptors: *The Netherlands, *Network design, *Discharge measurement, *Stream gages, IJssel River, Kalman filter algorithm, Model studies, Algorithms.

During the last decade much attention has been given to the question of optimizing data networks, probably due to the trade-off between required quality and cost. For the situation of a measurement system along a river, one of the objectives of the networks is that water levels and velocities can be interpolated within a desired accuracy from the available data. if this situation is obtained, a further question is to consider the possibility of dropping one or more measurement stations along the river. This possibility is evaluated here for the River IJssel in the Netherlands using a Kalman filter algorithm. A preliminary step in using this algorithm is the determination of the model for the flow pattern in the river. With knowledge of this model and given the available data from measuring stations along the River IJssel, calculation have been performed to show the effect of neglecting existing information in one or more points. By means of these calculations and a criterion on wanted accuracy, some idea can be given of the value of the measured information. The Kalman filter algorithm significantly reduced the standard error. The results suggested that the number of stations could be reduced from 10 to 6, or possibly 5, for a distance of 108 km. Optimal locations of gauges was not considered. (See also W90-01795) (Rochester-PTT)
W90-01823

**SPECIFIC HYDROMETRY OF KARST REGIONS.**
Split Univ. (Yugoslavia). Faculty of Civil Engineering Sciences.
O. Bonacci.
IN: Advances in Hydrometry: Proceedings of a symposium held during the First Scientific Assembly of the International Association of Hydrological Sciences at Exeter, U.K., 19-30 July 1982. International Association of Hydrological Sciences Publication 134. 1982. p 321-333, 6 fig, 9 ref.

Descriptors: *Instrumentation, *Hydrometry, *Yugoslavia, *Karst hydrology, *Discharge measurement, Springs, Ponors, Estavelles, Underground streams, Measuring instruments.

Gathering hydrologic data in karst regions is discussed, including: characteristics of karst geology, measurement methods for water phenomena in karst, determination of water losses along river channels in karst, and determination of the swallow capacity of ponors (i.e., a vertical shaft in limestone, possibly leading from the surface to a subsurface cave system). Spring discharge curves can be obtained using water levels measured in piezometric boreholes in karst. Measuring discharge and water losses are discussed, whether in stationary and stagnant conditions or in non-steady flows. Four methods of measurement considered suitable for karst are: (1) piezometric boreholes, (2) tracers, (3) speleological studies, and (4) remote sensing. Water losses along river channels must be determined using the relatively expensive and sensitive process of 'simultaneous measurements.' The swallow capacity of ponors or ponor zones (including estavelles) can be established indirectly by using the water budget in the polje together with the equation for the change of water volume in the reservoir. Equipment to be used in these studies must be of dimensions that do not change the conditions of the flow. Such devices have been designed at the Institute for Hydrotechnics of the Faculty of Civil Engineering, Sarajevo, Yugoslavia. Measurements are complex and demanding because of the complexity of the flow involved. Although some improvements are possible, experience has shown that the results obtained in complex situations are not always completely satisfactory and acceptable. (See also W90-01795) (Rochester-PTT)
W90-01824

**DEVELOPMENTS IN HYDROMETRY IN CENTRAL AMERICA AND BRAZIL.**
Projecto de Hidrologia e Climatologia da Amazonia, Belem (Brazil).
M. P. Dengo.
IN: Advances in Hydrometry: Proceedings of a symposium held during the First Scientific Assembly of the International Association of Hydrological Sciences at Exeter, U.K., 19-30 July 1982. International Association of Hydrological Sciences Publication 134. 1982. p 335-344, 2 fig, 4 ref.

Descriptors: *Hydrometry, *Discharge measurement, *Data acquisition, *Central America, *Brazil, *Developing countries, Reviews, Amazon River, Hydrology, Project on Hydrology and Climatology of Amazonia, International agreements, Backwater curve, Hysteresis loops, Mathematical models, Computer programs, Hydraulic models.

Developments in hydrometry occurring during the 1970-1980 decade in Central American countries and Brazil are reviewed and recent activities in hydrology and climatology in the River Amazon Basin are discussed. In addition, methods used by the Project on Hydrology and Climatology of Amazonia (PHCA) to evaluate stage-discharge relationships are considered. Both meteorological and hydrological networks in Central America are being strengthened and more attention is being paid to the optimal development of water resources for energy, agriculture, domestic and industrial water supply, recreation, flood mitigation, and other needs. The Regional Committee on Water Resources selected basins in each country for study networks, but lack of funds has prevented full implementation in all places. Studies in the Amazon Basin of Brazil have developed along three main lines: (1) a 'square grid' study to determine the minimum size of network capable of providing acceptable data; (2) design and implementation of a pilot telemetry network on the River Tocantins Basin to provide data for hydrological forecasting in connection with the Tucurui Hydroelectric Plant; and (3) mathematical modeling of the middle and lower Amazon River. Because low slopes and backwater effects are common in the rivers of the Amazon system, and dynamic loops are produced in the rating curves by changes in energy slope due to changing discharge, stage-discharge relationships are a problem. The effects of backwater in river gauging in the Amazon Basin have been dealt with by the 'backwater isolines method.' The problem of hysteresis loops has been approached through the use of a mathematical model, which has been successfully tested in Itapeua on the River Solimoes and in Obidoes on the River Amazon, where discharge values range from 80,000 to 250,000 cu m/sec. The model, in the form of a BASIC computer program, has given excellent results, but a major difficulty in applying it has been obtaining reliable slope measurements. (See also W90-01795) (Rochester-PTT)
W90-01825

**AUTOMATION OF DAILY WATER DISCHARGE COMPUTATION FOR RIVERS WITH DIFFERENT REGIMES.**
Sredneaziatskii Nauchno-Issledovatel'skii Gidrometeorologicheskii Inst., Tashkent (USSR).
Y. N. Ivanov.
IN: Advances in Hydrometry: Proceedings of a symposium held during the First Scientific Assembly of the International Association of Hydrological Sciences at Exeter, U.K., 19-30 July 1982. International Association of Hydrological Sciences Publication 134. 1982. p 345-352, 19 ref.

Descriptors: *Instrumentation, *Hydrometry, *USSR, *Hydrology, *Data processing, *Automation, *Discharge measurement, *Data acquisition, Ice jams, Bolster methods.

A system for processing hydrological data is proposed that allows the automation of the process of obtaining computerized daily water discharges, daily water stages, tables of measured water discharge, and icing conditions of a water body. The system of processing consists of an automated input of initial information and its processing, the evaluation of quantity and accuracy of water discharge data, and computation of parameters of the water discharge curves. The selection of a method for computation of daily water discharges is made automatically. Computation of discharge for the periods of out-of-bank flow and during freeze-up is realized by the methods accepted in the U.S.S.R. Discharge computation for periods of river bed deformation is made using a modification of the method of Bolster. Parts of this computation system have been tested with satisfactory results. Other aspects are awaiting further development. (See also W90-01795) (Rochester-PTT)
W90-01826

**ADVANCED HYDROLOGIC INSTRUMENTATION ACTIVITIES WITHIN THE WATER RESOURCES DIVISION OF THE US GEOLOGICAL SURVEY.**
Geological Survey, Reston, VA. Water Resources Div.
R. W. Paulson, R. H. Billings, and A. S. Cherdak.
IN: Advances in Hydrometry: Proceedings of a symposium held during the First Scientific Assembly of the International Association of Hydrological Sciences at Exeter, U.K., 19-30 July 1982. International Association of Hydrological Sciences Publication 134. 1982. p 353-359, 3 fig, 4 ref.

Descriptors: *Instrumentation, *Data acquisition, *Technology transfer, *Measuring instruments, *United States, *Hydrometry, *Adaptable Hydrologic *Geological Survey, Data Acquisition, Stream gages, Network design, Management planning.

Primary responsibility of water data in the United States lies with the Water Resources Division of the U.S. Geological Survey (USGS). A three-phase program is under way to define needs for field instrumentation and techniques, applicable technologies, and specific research and development plans. Two of the USGS's instrumentation projects that fit within this program of uprading technology are described: (1) a study of the time base of data sampling at fixed gauging stations and (2) the planning and development of a new field data acquisition system to replace the 12,000-15,000 mechanical punched-tape recorders now used in the USGS network. During the 1980-1981 period, a contractor performed three planning tasks as part of the Instrumentation Program: (1) developed a priority list and timetable of data system needs for the next 10 yr; (2) defined candidate technologies and time frames paralleling the products of task 1; and (3) developed a specific Research and Development Program Plan and recommended specific alternatives for upgrading the USGS data collection system. A study has been performed to test potential data-collection algorithms of future systems that will allow data to be collected on the basis of information content rather than elapsed time. The 'intelligent sampling

scheme' would perform differently for different streams, depending on individual stream characteristics. An Adaptable Hydrologic Data Acquisition System (AHDAS), tailored to fit the USGS's particularly requirements, is being developed based on the results of the three task-planning studies and the intelligent sampling study. AHDAS will be a system of complementary hardware and software modules that can be arranged and configured in 'building block' fashion to fit any practical hydrologic data requirement. A full conversion to the AHDAS system will take several years, giving opportunity for the training of operators and maintenance workers so that they are prepared for the issue of new instruments and equipment. (See also W90-01795) (Rochester-PTT)
W90-01827

**LARGE SCALE EFFECTS OF SEASONAL SNOW COVER.**
For primary bibliographic entry see Field 2C.
W90-01850

**IMPORTANCE AND EFFECTS OF SEASONAL SNOW COVER.**
Eidgenoessisches Inst. fuer Schnee- und Lawinenforschung, Davos (Switzerland).
For primary bibliographic entry see Field 2C.
W90-01860

**OPERATIONAL AIRBORNE MEASUREMENTS OF SNOW WATER EQUIVALENT AND SOIL MOISTURE USING TERRESTRIAL GAMMA RADIATION IN THE UNITED STATES.**
National Weather Service, Minneapolis, MN. Office of Hydrology.
For primary bibliographic entry see Field 2C.
W90-01869

**DETERMINATION OF WATER EQUIVALENT OF SNOW AND THE FORECAST OF SNOWMELT RUNOFF BY MEANS OF ISOTOPES IN TURKEY.**
State Hydraulic Works, Ankara (Turkey). Technical Research and Quality Control Dept.
For primary bibliographic entry see Field 2C.
W90-01870

**REMOTE SENSING OF SNOW.**
Innsbruck Univ. (Austria). Inst. fuer Meteorologie und Geophysik.
For primary bibliographic entry see Field 2C.
W90-01874

**DISCUSSION OF THE ACCURACY OF NOAA SATELLITE-DERIVED GLOBAL SEASONAL SNOW COVER MEASUREMENTS.**
Satellite Hydrology, Inc., Vienna, VA.
For primary bibliographic entry see Field 2C.
W90-01875

**REMOTE SENSING OF SNOW CHARACTERISTICS IN THE SOUTHERN SIERRA NEVADA.**
California Univ., Santa Barbara. Center for Remote Sensing and Environmental Optics.
For primary bibliographic entry see Field 2C.
W90-01876

**ANALYSIS OF INTERANNUAL VARIATIONS OF SNOW MELT ON ARCTIC SEA ICE MAPPED FROM METEOROLOGICAL SATELLITE IMAGERY.**
Lamont-Doherty Geological Observatory, Palisades, NY.
For primary bibliographic entry see Field 2C.
W90-01877

**SNOW MELT ON SEA ICE SURFACES AS DETERMINED FROM PASSIVE MICROWAVE SATELLITE DATA.**
Scripps Institution of Oceanography, La Jolla, CA.
For primary bibliographic entry see Field 2C.
W90-01878

**ESTIMATING SNOWPACK PARAMETERS IN THE COLORADO RIVER BASIN.**
National Aeronautics and Space Administration, Greenbelt, MD. Goddard Space Flight Center.
For primary bibliographic entry see Field 2C.
W90-01879

**GLOBAL SNOW COVER AND THE EARTH'S ROTATION.**
National Aeronautics and Space Administration, Greenbelt, MD. Goddard Space Flight Center.
For primary bibliographic entry see Field 2C.
W90-01881

**DISTRIBUTION OF SNOW EXTENT AND DEPTH IN ALASKA AS DETERMINED FROM NIMBUS-7 SMMR MAPS (1982-83).**
National Aeronautics and Space Administration, Greenbelt, MD. Goddard Space Flight Center.
For primary bibliographic entry see Field 2C.
W90-01884

**BIDIRECTIONAL REFLECTANCE OF SNOW AT 500-600 NM.**
Cooperative Inst. for Research in Environmental Science, Boulder, CO.
For primary bibliographic entry see Field 2C.
W90-01885

**PHYSICAL BASIS OF ICE SHEET MODELLING.**
For primary bibliographic entry see Field 2C.
W90-01886

**IS THE CREEP OF ICE REALLY INDEPENDENT OF THE THIRD DEVIATORIC STRESS INVARIANT.**
Wisconsin Univ.-River Falls. Dept. of Plant and Earth Sciences.
For primary bibliographic entry see Field 2C.
W90-01888

**CRYSTALLINE FABRIC OF POLAR ICE SHEETS INFERRED FROM SEISMIC ANISOTROPY.**
Wisconsin Univ.-Madison. Geophysical and Polar Research Center.
For primary bibliographic entry see Field 2C.
W90-01889

**CONSTITUTIVE PROPERTIES OF ICE AT DYE 3, GREENLAND.**
Copenhagen Univ. (Denmark). Geophysical Inst.
For primary bibliographic entry see Field 2C.
W90-01890

**ENHANCED FLOW OF WISCONSIN ICE RELATED TO SOLID CONDUCTIVITY THROUGH STRAIN HISTORY AND RECRYSTALLIZATION.**
Geological Survey of Canada, Ottawa (Ontario). Terrain Sciences Div.
For primary bibliographic entry see Field 2C.
W90-01891

**MECHANICAL BEHAVIOR OF ANISOTROPIC POLAR ICE.**
Laboratoire de Glaciologie et Geophysique de l'Environnement, Saint-Martin d'Heres (France).
For primary bibliographic entry see Field 2C.
W90-01892

**FLOW VELOCITY PROFILES AND ACCUMULATION RATES FROM MECHANICAL TESTS ON ICE CORE SAMPLES.**
State Univ. of New York at Buffalo. Ice Core Lab.
For primary bibliographic entry see Field 2C.
W90-01893

**CONTINUOUS TILL DEFORMATION BENEATH ICE SHEETS.**
Wisconsin Univ., Madison. Geophysical and Polar Research Center.
For primary bibliographic entry see Field 2C.
W90-01894

**ANOMALOUS HEAT FLOW AND TEMPERATURES ASSOCIATED WITH SUBGLACIAL WATER FLOW.**
Alaska Univ., Fairbanks. Geophysical Inst.
For primary bibliographic entry see Field 2C.
W90-01895

**ICE SHEET ELEVATION CHANGES FROM ISOTOPE PROFILES.**
Washington Univ., Seattle. Quaternary Isotope Lab.
For primary bibliographic entry see Field 2C.
W90-01909

**DERIVATION OF PALEOELEVATIONS FROM TOTAL AIR CONTENT OF TWO DEEP GREENLAND ICE CORES.**
Schlumberger-Doll Research Center, Ridgefield, CT.
For primary bibliographic entry see Field 2C.
W90-01910

**USE OF TRACE CONSTITUENTS TO TEST FLOW MODELS FOR ICE SHEETS AND ICE CAPS.**
Department of Energy, Mines and Resources, Ottawa (Ontario). Polar Continental Shelf Project.
For primary bibliographic entry see Field 2C.
W90-01911

**CONSTRAINTS ON MODELS IN THE ROSS EMBAYMENT, ANTARCTICA.**
Wisconsin Univ., Madison. Geophysical and Polar Research Center.
For primary bibliographic entry see Field 2C.
W90-01912

**FORCE BALANCE OF RUTFORD ICE STREAM, ANTARCTICA.**
British Antarctic Survey, Cambridge (England).
R. M. Frolich, D. R. Mantripp, D. G. Vaughan, and C. S. M. Doake.
IN: The Physical Basis of Ice Sheet Modeling. International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. 1987. p 323-331, 8 fig, 15 ref.

Descriptors: *Glaciology, *Ice sheets, *Model studies, *Glaciohydrology, *Glaciers, *Ice streams, *Antarctica, Shear stress, Satellite technology, Remote sensing.

Data are presented along a 60 km survey network on Rutford Ice Stream, Antarctica. The network follows closely a streamline and is situated above the grounding line. Measurements of velocity, strain rate, surface elevation and ice thickness allow a preliminary interpretation of the flow regime. A prominent feature is a rise in the bed of 500 m, over which the ice must flow. The surface expression of this step is seen in Landsat satellite images as a surface knoll whose shape emphasizes that the flow must be considered using a full three dimensional analysis. Vertical shear stress gradients appear to be important within about 20 km of the knoll. (See also W90-01886) (Author's abstract)
W90-01913

**GEOLOGICAL EVIDENCE TO CONSTRAIN MODELLING OF THE LATE PLEISTOCENE RHONEGLETSCHER (SWITZERLAND).**
Eidgenoessische Technische Hochschule, Zurich (Switzerland). Versuchsanstalt fuer Wasserbau, Hydrologie und Glaziologie.
For primary bibliographic entry see Field 2C.
W90-01914

**PROBLEMS OF TESTING ICE SHEET MODELS: A BRITISH CASE STUDY.**
Edinburgh Univ. (Scotland). Dept. of Geography.
For primary bibliographic entry see Field 2C.
W90-01918

## 7C. Evaluation, Processing and Publication

**UNCERTAINTY ANALYSIS OF RUNOFF ESTIMATES FROM A RUNOFF CONTOUR MAP.**
NSI Technology Services Corp., Corvallis, OR.
For primary bibliographic entry see Field 2E.
W90-00962

**SAGEBRUSH RANGELAND HYDROLOGY AND EVALUATION OF THE SPUR HYDROLOGY MODEL.**
Agricultural Research Service, Boise, ID. Northwest Watershed Research Center.
For primary bibliographic entry see Field 2E.
W90-00981

**ENERGY-FLOW RESPONSE MODELS FOR EVALUATION OF ALTERED RIPARIAN VEGETATION IN THREE SOUTHEAST ALASKAN STREAMS.**
Idaho Univ., Moscow. Dept. of Plant, Soil and Entomological Sciences.
For primary bibliographic entry see Field 2H.
W90-00994

**METHOD FOR CONSERVING CORE-STORAGE AND COMPUTING TIME IN AQUIFER SIMULATION MODELS.**
Zimbabwe Univ., Harare. Dept. of Geology.
A. J. Beasley.
Journal of Hydrology JHYDA7, Vol. 108, No. 1-4, p 111-121, Jun 1989. 1 fig, 1 tab, 11 ref.

Descriptors: *Model studies, *Computer programs, *Finite difference methods, *Aquifers, *Computer models, *Mathematical models, *Simulation, Computer programs.

Most aquifers are not rectangular on the map, so if a finite-difference grid is superimposed for modelling purposes, many of the nodes fall outside the aquifer boundary. Generally, aquifer simulation programs store the hydraulic head and various parameters for each node in arrays which have the same dimensions as those of the superimposed grid, implying wastage of computer storage on dummy nodes outside the aquifer boundary, and wastage of computer time in processing dummy data at such nodes. A method is described in which nodes are numbered explicitly in a 2-dimensional array, and the nodal parameters are stored in linear arrays using the node numbers as indices; storage is conserved because the linear arrays need by only as large as the number of nodes inside the aquifer boundary. Using the method in a simple model in which 35% of the nodes are outside the aquifer boundary resulted in savings of 28% in storage and 35% in running time. A further development of the method stores numbers in a linear array, resulting in a 43% reduction in running time for the same model. For aquifers with highly irregular boundaries, where a larger proportion of the nodes are outside the aquifer boundary, proportionately greater economies in storage and running time will result. (Author's abstract)
W90-01022

**USING HISTORICAL DATA IN NONPARAMETRIC FLOOD ESTIMATION.**
Waikato Univ., Hamilton (New Zealand). Dept. of Earth Sciences.
For primary bibliographic entry see Field 2E.
W90-01028

**GEOSTATISTICAL TOOL FOR DROUGHT MANAGEMENT.**
Georgia Inst. of Tech., Atlanta. School of Civil Engineering.
For primary bibliographic entry see Field 2E.
W90-01029

**APPLICATION OF A DIGITAL FILTER FOR MODELLING RIVER SUSPENDED SEDIMENT CONCENTRATIONS.**
Geneva Univ. (Switzerland). Inst. F.-A. Forel.
For primary bibliographic entry see Field 2J.
W90-01030

**DETERMINING RUNOFF ROUTING MODEL PARAMETERS WITHOUT RAINFALL DATA.**
Wollongong Univ. (Australia). Dept. of Civil and Mining Engineering.
For primary bibliographic entry see Field 2E.
W90-01031

**MONTE CARLO COMPARISON OF PARAMETRIC AND NONPARAMETRIC ESTIMATION OF FLOOD FREQUENCIES.**
Ottawa Univ. (Ontario). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W90-01032

**NEW STATISTICAL GRAIN-SIZE METHOD FOR EVALUATING THE HYDRAULIC CONDUCTIVITY OF SANDY AQUIFERS.**
Nigeria Univ., Nsukka. Dept. of Geology.
For primary bibliographic entry see Field 2F.
W90-01035

**COMPARISONS OF THE UNSATURATED HYDRAULIC CONDUCTIVITY OF A COARSE-TEXTURED SOIL AS DETERMINED IN THE FIELDS, IN THE LABORATORY, AND WITH MATHEMATICAL MODELS.**
Ghent Rijksuniversiteit (Belgium). Lab. of Soil Physics, Soil Conditioning and Horticultural Soil Science.
For primary bibliographic entry see Field 2G.
W90-01063

**OPERATIONAL IMPLEMENTATION OF A FLOOD FORECAST (MISE EN OEUVRE OPERATIONNELLE D'UNE PREVISION DES CRUES).**
Ministere de l'Environnement, Neuilly-sur-Seine (France).
D. Duband, C. Parsy, C. Lefevre, J. Leoussoff, and J. Vidal.
La Houille Blanche HOBLAB, Vol. 5, No. 6, p 365-374, 1988. 1 tab. English summary.

Descriptors: *Flood forecasting, *Computer programs, *Floods, *Data acquisition, Model studies, France.

The operational implementation and evaluation concerning flood forecasting is examined. The forecast is possible only downstream of a reliable and efficient system for capturing data, due to the difficulties encountered in the relationship between the data collecting system and the forecast software. The programming structures used and the perspectives were analyzed based on flood forecasting on a number of rivers in France, such as the Loire, the Gard, and the Garonne, and the Nilwala in Sri Lanka. A program for flood forecasting has been written in Fortran 77 and can be used on IBM compatible PCs (MS-DOS). A list of other programs that may be used for flood forecasting is being compiled but is not exhaustive. The specifics of one such program, PREREG, are given. (Peters-PTT)
W90-01128

**PRACTICAL COMPARISON OF FLOOD FORECAST METHODS. EXAMPLE OF THE AVEYRON RIVER (COMPARAISON PRATIQUE DE METHODES DE PREVISION DE CRUE. EXEMPLE DE L'AVEYRON).**
Centre National de la Recherche Scientifique, Toulouse (France). Inst. de Mecanique des Fluides.
C. Thirriot, J. P. Bernede, and H. Habaieb.
La Houille Blanche HOBLAB, Vol. 5, No. 6, p 385-593, 1988. 11 fig, 5 tab, 29 ref. English summary.

Descriptors: *Flood forecasting, *Mathematical analysis, *Regression analysis, *Comparison studies, Aveyron River, Floods.

Forecast flow rates obtained by numerical simulation are compared with the rates actually measured during the occurrence of about thirty floods on the River Aveyron. The forecast algorithms tested are simple yet numerous. The comparison criteria used are the standard deviation of values provided during a flood and the error on the maximum flow. An improvement is being sought according to three concepts: (1) the use of the Kalman non-quantified filtering method; (2) continuous competition of methods during floods; and (3) the mixing of results using several additional methods. With the collaboration of hydrology students and qualified forecasters, two forecast experiments have been made to be able to understand more of the mental mechanisms of weather forecasts with a view to setting up an expert system. (Author's abstract)
W90-01131

**REAL TIME DECISION PROCEDURES RELATING TO FLOOD FORECASTING (LES PROCEDURES DE DECISION EN TEMPS REEL POUR LA PREVISION DES CRUES).**
Centre d'Enseignement et de Recherche pour la Gestion des Ressources Naturelles et l'Environnement, Paris (France).
P. A. Roche, and J. P. Torterotot.
La Houille Blanche HOBLAB, Vol. 5, No. 6, p 399-409, 1988. 10 fig, 2 tab, 14 ref. English summary.

Descriptors: *Flood forecasting, *Decision making, *Statistical analysis, *Model studies, Error analysis, Stochastic process, Multimodels.

Application examples are used to explain how it is possible to provide an elaborated forecast using simulation models and various real-time decision procedures. Correction of forecast errors via the analysis of error stochastic process is currently used. Model parameter filtering is also used in special cases over the past 10 years. More recently, procedures known as multimodels have been introduced. They involve either deciding to replace the current model in the case of failure or to combine the results with a weighting suited to the current state of the system at the time of forecast. (Author's abstract)
W90-01132

**RAIN-FLOW RATE MODELLING. A CONTRIBUTION TO THE DEVELOPMENT OF THE DPFT METHOD (MODELISATION PLUIE-DEBIT: VALIDATION PAR SIMULATION DE LA METHODE DPFT).**
Institut de Mecanique de Grenoble, Saint-Martin d'Heres (France).
I. Nalbantis, C. Obled, and Y. Rodriguez.
La Houille Blanche HOBLAB, Vol. 5, No. 6, p 415-424, 1988. 6 fig, 13 ref. English summary.

Descriptors: *Model studies, *Rainfall-runoff relationships, *Flow rates, Algorithms, Mathematical analysis.

A set of algorithms seeking to improve the implementation and accuracy of the DPFT method, which is based on the transfer function, is proposed. In treatments concerning real data, the absence of exact reference values makes it difficult to discriminate between methods. It was decided, therefore, to use data generated by a known model, whose inputs and outputs, as well as the intermediate data such as accurate rainfall amount and the transfer function, are known. Using accurate input and output data the most appropriate algorithms, as well as the sensitivity of the method to various types of context or errors, was assessed. (Author's abstract)
W90-01133

**USE OF SOIL MOISTURE STATE INDICATORS IN A RAINFALL-RUNOFF MODEL (UTILISATION D'INDICATEURS DE L'ETAT HYDRIQUE DU SOL DANS UN MODELE PLUIE-DEBIT).**
Centre National du Machinisme Agricole, du Genie Rural, des Eaux et des Forets, Antony (France).
C. Loumagne, C. Michel, and M. Normand.
La Houille Blanche HOBLAB, Vol. 5, No. 6, p 425-432, 1988. 2 fig, 6 tab, 6 ref. English summary.

Descriptors: *Model studies, *Rainfall-runoff relationships, *Flow rates, *Flood forecasting, Statistical analysis, Yield equations, Soil water potential, Water potentials.

Research was conducted on the direct measurement of soil moisture for flow rate forecast models following a statistical study which demonstrated the full power of soil moisture input with respect to the yield function. The results using a conceptual model with tanks simulating a continuous chronicle of an end time step flow are discussed. The results confirm the benefits of introducing soil moisture or water potential data in the place of evaporation. (Author's abstract)
W90-01134

**COMOD: SELECTOR SOFTWARE FOR DIFFUSING WAVE MODELS AND THEIR CHARACTERISTICS (C.O.M.O.D.: LOGICIEL DE CHOIX DE MODELES D'ONDES DIFFUSANTES ET DE LEURS CARACTERISTIQUES).**
Montpellier-2 Univ. (France). Lab. d'Hydrologie Mathematique.
C. Bocquillon, and R. Moussa.
La Houille Blanche HOBLAB, Vol. 5, No. 6, p 433-437, 1988. 6 fig, 1 tab, 6 ref. English summary.

Descriptors: *Computer programs, *Flood routing, *Model studies, Algorithms, Flood waves, Errors, Mathematical equations, Floods.

Flood routing in rivers generally has the characteristic of a diffusing wave (negligible acceleration terms in Saint-Venant's equations). Many methods exist to solve these equations. The choice of a method, time and space steps to be retained depend on many factors: the form of the upstream flood, the complexity of the hydrographical network, the structures of river ponds, the location of measurement stations and the recording step. The optimized choice interactive program concerning the diffusing wave method (COMOD) guides the user in his choices and specifies the error introduced by the retained computation algorithm. (Author's abstract)
W90-01135

**COMPUTERIZATION OF THE BACHET METHOD (INFORMATISATION DE LA METHODE BACHET).**
Laboratoire National d'Hydraulique, Chatou (France).
J. Miquel, and A. Lebosse.
La Houille Blanche HOBLAB, Vol. 5, No. 6, p 439-443, 1988. 3 fig. English summary.

Descriptors: *Hydrograph analysis, *Computer programs, *Flood hydrographs, *Hydrographs, Bachet method, Transfer function.

With a view to simplifying the use of the Bachet Method, an interactive software has been designed which allows for the adjustment or testing of the method on a series of flood hydrographs. The computerization of simple geometrical constructions depends on the construction principles of the Bachet rules. The adjustment consists of evaluating two functions known as the 'Attenuation Cord' and 'Transfer Time', which can be carried out either on natural hydrographs or converted hydrographs. During the test, the first function converts an upstream hydrograph into an attenuated hydrograph, then the second function converts this attenuated hydrograph into a downstream hydrograph. The cases concerning these confluents are currently not dealt with. (Author's abstract)
W90-01136

**PROPAGATION OF FLOODS WITH THE CONSTRAINED LINEAR SYSTEM (CLS). REAL TIME APPLICATION IN THE FORECAST INFORMATION SYSTEM (PROPAGATION DES CRUES AVEC LE CONSTRAINED LINEAR SYSTEM (CLS): APPLICATION EN TEMPS REEL DANS LE SYSTEME INFORMATIQUE DE PREVISION).**
LHF, 6, Rue de Lorraine, 38130 Echirolies, France.
M. Erlich.
La Houille Blanche HOBLAB, Vol. 5, No. 6, p 445-450, 1988. 6 fig, 1 tab, 6 ref. English summary.

Descriptors: *Flood forecasting, *Hydrologic models, *Model studies, *Floods, *Constrained linear system, Niger River, Algorithms, Transfer function, Comparison studies.

A model constructed with the constrained linear system (CLS) is derived from a systematic approach based on the evaluation of the transfer function between several hydrologic inputs and one output in the form of a linear relation. A general description of the model is given, taking into account of the linearities of a hydrological system, and real time application (modeling of residues, degraded mode). Four CLS models were studied during the construction phase of the HYDRONIGER project in the middle section of the Niger River. The models varied in the number of constraints Model M1, no constraints; model M2, only positive constraints; Model M3, two types of constraints, non-negative and continuous; and Model M4, the same as Model M2 but with an option for autoregressive modeling of the outflow. The CLS model gave comparable results to those of the Muskingum model when applied to the same section of the Niger. (Peters-PTT)
W90-01137

**QUANTITATIVE RAINFALL FORECAST (PREVISION QUANTITATIVE DES PRECIPITATIONS).**
Meteorologie Nationale, Paris (France). Div. Prevision.
Y. Veyrier.
La Houille Blanche HOBLAB, Vol. 5, No. 6, p 451-456, 1988. 3 fig, 2 tab, 5 ref. English summary.

Descriptors: *Computer programs, *Model studies, *Weather forecasting, *France, PERIDOT model, Meteorology.

The state of quantitative rainfall forecasting at the French State Meteorological Observatory is reviewed. The forecast system is briefly described, with special emphasis on the characteristics of rainfall. Several follow up and quality control results of the numerical amounts of rainfall, mainly derived from the PERIDOT mesoscale model, which was put into operation in 1985, are specified. It demonstrates a potential which opens new perspectives for these types of forecasts. Rainfall simulations using the PERIDOT model are reported both for France and the U.S. (Peters-PTT)
W90-01138

**HIGH-RESOLUTION PROFILES OF TEMPERATURE AND DISSOLVED OXYGEN IN A RIVER.**
Queensland Univ., Brisbane (Australia). Dept. of Physics.
J. G. Steele.
Hydrobiologia HYDRB8, Vol. 179, No. 1, p 17-24, July 21, 1989. 8 fig, 9 ref.

Descriptors: *Water quality, *Monitoring, *Estuaries, *Network design, *Temperature, *Dissolved oxygen, *Tidal rivers, *River forecasting, *Flow profiles, Stream profiles, Conductivity, Australia, Current meters.

Longitudinal profiles of water quality along a well-mixed tidal river are, ideally, based on simultaneous measurements at fixed stations distributed along the river. The resolution of the profiles is limited by the density of the stations. However, for a given number of stations the resolution is greatly increased if water quality data can be extrapolated upstream and downstream of the stations, making use of velocity data; the resolution is then determined by the density of the extrapolated data point, which may be an order of magnitude higher than the density of the stations. A 15-km length of river was investigated using 5 current meters equipped to measure depth, temperature, conductivity and dissolved oxygen. Data were recorded simultaneously every 10 minutes. When the average cross-sectional speed was 0.25 m/sec (typical of tidal conditions), the extrapolated data points were 150 m apart, so the resolution of the resulting profiles (7 per kilometer) was much higher than that of the stations alone (0.3 per kilometer). The extrapolation process required a means of deducing the average cross-sectional speed from the speed measured at a given station. The key to this was provided by temperature data recorded during the onset of a spate, when tidal flow was suspended and the average cross-sectional speed was uniformly about 0.75 m/sec at four of the stations. Profiles of temperature and dissolved oxygen were generated by this method; the resolution was about 2 data points/km during the onset of the spate, and 6 points/km during tidal flow. (Author's abstract)
W90-01152

**HYDRAULIC CALCULATION OF FREE-FLOW EDDY SPILLWAYS.**
A. L. Zuikov, and G. A. Chepaikin.
Hydrotechnical Construction HYCOAR, Vol. 22, No. 11, p 648-652, May 1989. 2 fig, 6 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 11, p 25-28, November 1988.

Descriptors: *Flow characteristics, *Eddies, *Spillways, *Hydraulic properties, *Pressure head, *Fluid mechanics, Mathematical studies, Mathematical equations, Flow velocity, Hydraulic loss.

One of the promising directions for reducing the cost and increasing the reliability of high-head spillways is the use of eddy systems in which the flow is swirled in the outlet section. Swirling of the flow increases the pressure on the walls of the waterway as a result of the effect of centrifugal forces; simultaneously, the wall velocities decrease, which substantially improves the cavitation conditions on the linings. The characteristics of the hydraulic calculations of free-flow eddy spillway systems are examined. Calculation of the main dimensions of the gate and swirl chamber, as well as of the main characteristics of the swirled flow at the entrance to the outlet conduit in the case of a horizontal layout of the spillway reduces to the solutions of three equations: conservation of energy, of momentum, and of continuity. The theoretical analysis and prediction of the characteristics and operating conditions of free-flow eddy spillways also takes into account the size and shape of the waterway, hydraulic losses of energy in the influent conduits, regulating gates, and due to wall friction. The derived analytical formulas and relations enable calculation of the geometric parameters of the spillways, flow regime, and characteristics of the flow in them in conformity with given values of the head and discharge. The calculations confirm that in free-flow eddy spillways, the excess kinetic energy of the discharge is effectively dissipated due to an increase of hydraulic losses during swirling of the flow along the length of the outlet conduit. The calculations agree well with the experimental data and can be recommended for practical use when designing. However, they do not eliminate the need for laboratory hydraulic investigations of the selected design variant of the free-flow eddy spillway. (Friedmann-PTT)
W90-01201

**OPTIMAL VOLUMETRIC AND ECONOMIC GROUNDWATER MINING FOR THE ARKANSAS GRAND PRAIRIE.**
Utah State Univ., Logan. Dept. of Agricultural and Irrigation Engineering.
For primary bibliographic entry see Field 2F.
W90-01218

**TREATMENT OF SPATIALLY VARIABLE GROUNDWATER LEVELS IN ONE-DIMEN-**

**SIONAL STOCHASTIC UNSATURATED WATER-FLOW MODELING.**
Agricultural Univ., Wageningen (Netherlands). Dept. of Hydraulics and Catchment Hydrology.
For primary bibliographic entry see Field 2F.
W90-01219

**ASSESSMENT OF DYNAMIC MODELS FOR A HIGH RATE ANAEROBIC TREATMENT PROCESS.**
Environmental Protection Service, Burlington (Ontario). Waste Water Technology Centre.
For primary bibliographic entry see Field 5D.
W90-01232

**OPTIMIZATION OF THE EWENS/CASWELL NEUTRAL MODEL PROGRAM FOR COMMUNITY DIVERSITY ANALYSIS.**
British Museum of Natural History, London (England). Biometric Section.
N. Goldman, and P. J. D. Lambshead.
Marine Ecology Progress Series MESEDT, Vol. 50, No. 3, p 255-261, January 2, 1989. 2 fig, 12 ref, append.

Descriptors: *Limnology, *Ecology, *Model studies, *Computer models, *Mathematical models, Benthic ecology, Community diversity analysis, Computer programs.

The neutral model program of Ewens was introduced into ecology by Caswell and has become a useful tool for benthic ecology. However, the program as written by Ewens was not developed for high speed or low memory requirements, as these factors were not apparently a significant problem with the size of data sets used in population genetics. Computer memory and speed restrictions often become significant with ecological data. This paper reports on an improved version of Ewens' program, suitable for microcomputers. The new version has been optimized for both speed and memory requirement. The program calculates H' (Shannon diversity Index), E(H') (expected H' for a neutral sample), SD(H') (standard deviation of E(H') and V (number of standard deviations H' is from E(H'). A statistical test of neutrality is possible, under the assumption that H'/log(k) has a beta distribution. The program calculates the appropriate F-statistic, together with its (non-integer) degrees of freedom. The improved program allows most practical problems to be analyzed routinely, with acceptable run-times. For example, a 40 x 400 data set which was a realistic limit on microcomputers now runs in under 30 s. This greatly enhances the utility of neutral model analysis as the method of choice for diversity analysis, even with the largest practically possible data sets. (Sand-PTT)
W90-01326

**ANALYSIS AND EVALUATION OF A WASTEWATER TREATMENT PLANT MODEL BY STOCHASTIC OPTIMIZATION.**
Santiago Univ. (Spain). Dept. of Chemical Engineering.
For primary bibliographic entry see Field 5D.
W90-01336

**PRESENT CLIMATE AND GLACIATION OF WESTERN MONTANA, U.S.A.**
Montana State Univ., Bozeman. Dept. of Earth Sciences.
For primary bibliographic entry see Field 2C.
W90-01338

**POLLUTANT WASHOFF UNDER NOISE-CORRUPTED RUNOFF CONDITIONS.**
McMaster Univ., Hamilton (Ontario). Dept. of Civil Engineering and Engineering Mechanics.
For primary bibliographic entry see Field 5B.
W90-01349

**MODELS OF THE DEVELOPMENT OF SNOW MANTLE AND OF SNOWMELT (MODELES D'EVOLUTION DU MANTEAU NIVAL ET DE LA FONTE DES NEIGES).**
Hydro-Quebec, Montreal. Service Production.
For primary bibliographic entry see Field 2C.
W90-01362

**STATISTICAL LONG-RANGE TRANSPORT MODEL FOR SIMULATION OF WET SULPHATE DEPOSITION.**
Waterloo Univ. (Ontario). Dept. of Chemical Engineering.
For primary bibliographic entry see Field 5B.
W90-01363

**LEACHATE: PRODUCTION AND CHARACTERIZATION.**
Waterloo Univ. (Ontario). Dept. of Chemical Engineering.
For primary bibliographic entry see Field 5B.
W90-01367

**COMPARATIVE STUDY OF THREE DYNAMIC ACTIVATED SLUDGE MODELS (ETUDE COMPARATIVE DE TROIS MODELES DYNAMIQUES DE BOUES ACTIVEES).**
Institut National de la Recherche Scientifique, Sainte-Foy (Quebec).
For primary bibliographic entry see Field 5D.
W90-01369

**MAPPING REGIONAL FOREST EVAPOTRANSPIRATION AND PHOTOSYNTHESIS BY COUPLING SATELLITE DATA WITH ECOSYSTEM SIMULATION.**
Montana Univ., Missoula. School of Forestry.
For primary bibliographic entry see Field 2D.
W90-01371

**DETERMINATION OF THE EXPONENTIAL UNSATURATED HYDRAULIC CONDUCTIVITY FUNCTION BY PARAMETER IDENTIFICATION.**
Agricultural Univ. of Warsaw (Poland). Dept. of Land Reclamation.
For primary bibliographic entry see Field 2G.
W90-01392

**SEMI-AUTOMATIC METHOD TO QUANTIFY AND IDENTIFY ZOOPLANKTON.**
Hydrological Research Inst., Pretoria (South Africa).
For primary bibliographic entry see Field 2H.
W90-01402

**COMPUTER CODE FOR THE CALCULATION OF THE RELATIVE TRANSMISSIVITY DISTRIBUTION IN AN AQUIFER FOR STEADY STATE GROUNDWATER LEVELS.**
Orange Free State Univ., Bloemfontein (South Africa). Inst. for Groundwater Studies.
For primary bibliographic entry see Field 2F.
W90-01404

**TEMPERATURE DATA AVAILABLE ON THE DEPARTMENT OF WATER AFFAIRS' CHEMICAL DATA BASE.**
Hydrological Research Inst., Pretoria (South Africa).
For primary bibliographic entry see Field 7B.
W90-01407

**COMPUTER METHODS AND WATER RESOURCES: FIRST INTERNATIONAL CONFERENCE, MOROCCO 1988.**
Vol. 3, Computational Hydrology. Computational Mechanics Publications, Boston. 1988. 306 p. Edited by D. Ouazar, C. A. Brebbia, and V. de Kosinsky.

Descriptors: *Hydraulics, *Model studies, *Computer models, *Hydrology, *Aquifers, *Groundwater movement, *Geohydrology, *Water management, Deterministic models, Stochastic models, Stochastic process, Probabilistic process.

This volume contains papers related to computational hydrology submitted to the 1st International Conference in Africa on Computer Methods and Water Resources, held at Rabat, Morocco, March 14-18th, 1988. The papers discuss advanced computational techniques developed for the efficient utilization of water resources, particularly useful to developing countries as they can provide a way of optimizing their resources. Six areas are covered: groundwater and aquifer modeling, computational hydraulics, computational hydrology, computer aided engineering in water resources, computational transport phenomena, and water quality, planning and management. Included are contributions on deterministic and stochastic modeling, risk analysis in normal, arid and semi-arid lands, subsurface hydrology and urban hydrology modeling. Some papers are related to the development of software codes and their applications. (See W90-01410 thru W90-01431) (Freidman-PTT)
W90-01409

**EFFECTS OF THE LENGTH OF RECORD ON ESTIMATES OF ANNUAL AND SEASONAL PRECIPITATION.**
Nevada Univ. System, Las Vegas. Water Resources Center.
R. H. French.
IN: Computer Methods and Water Resources: First International Conference, Morocco, 1988. Vol. 3, Computational Hydrology. Computational Mechanics Publications, Boston. 1988. p 3-13, 2 fig, 2 tab, 10 ref. DOE Contract DE-AC08-85NV10384.

Descriptors: *Semiarid lands, *Precipitation, *Rain gages, *Meteorological data collection, *Deserts, Data collections, Groundwater recharge, Aquifers, Nevada.

The effect of adding approximately six years of data to a precipitation data base consisting of eleven gages on the Nevada Test Site, Nevada, was examined. It is concluded that one effect of lengthening the period of record at typical desert precipitation gaging sites can be a significant change in the estimate of potential groundwater recharge. In addition, six of the eleven sites used in this study exhibit a trend toward increasing annula and seasonal precipitation and increasing variability of summer season precipitation. Such a trend can have significant effects on both water resources management and erosion control. (See also W90-01409) (Author's abstract)
W90-01410

**GENERATION OF SYNTHETIC RAINFALL SEQUENCES OF MULTIPLE STATIONS USING THE ANALYSIS OF VARIANCE MODEL.**
Universidade Federal da Paraiba, Campina Grande (Brazil). Dept. of Civil Engineering.
V. S. Srinivasan, and H. P. Gomes.
IN: Computer Methods and Water Resources: First International Conference, Morocco, 1988. Vol. 3, Computational Hydrology. Computational Mechanics Publications, Boston. 1988. p 37-49, 5 fig, 5 tab, 8 ref.

Descriptors: *Model studies, *Analysis of variance, *Rainfall, *Semiarid lands, *Meteorological data collection, *Rain gages, Statistical models, Hydrologic models, Networks, Brazil.

A synthetic generation model for obtaining the daily precipitation series for various stations within a single watershed is presented. The representative basin of Oscar Barro sin the semi-arid region of the northeast of Brazil with its precipitation network data, observed between 1970 and 1976, were used for this purpose. The precipitation sequence for each of the rain gage stations was derived from the application of the analysis of variance technique with two-way classification. The mean precipitation of the day over the basin itself was obtained by sampling a Gamma distribution that was fitted to the observed values. The generated sequences were found to conserve well the statistical properties of the observed series. (See also W90-01409) (Author's abstract)
W90-01413

**DEVELOPMENT OF A MODEL FOR PRODUCTION OF WATER TRANSFER IN A SEMI-ARID ZONE IN TUNISIA (ELABORATION D'UN MODELE DE PREDICTION DU TRANSFERT HYDRIQUE SOUS JACHERE DANS LES ZONES SEMI-ARIDES DE LA TUNISIE).**
Institut National Agronomique de Tunis (Tunisia).
Centre de Gestion des Ressources en Eau.
For primary bibliographic entry see Field 3F.
W90-01415

**ESTIMATION OF RIVER FLOOD DISCHARGES USING THE COMPUTER PROGRAM HYFA.**
International Inst. for Hydraulic and Environmental Engineering, Delft (Netherlands).
For primary bibliographic entry see Field 2E.
W90-01416

**COMPUTER MODELS OF CATCHMENT RUNOFF.**
Krakow Technical Univ. (Poland). Inst. of Water Engineering.
For primary bibliographic entry see Field 2E.
W90-01418

**COMPUTER MODEL FOR PREDICTING RUNOFF FROM A BENCH TERRACED FIELD.**
Central Soil and Water Conservation Research and Training Inst., Dehra Dun (India).
For primary bibliographic entry see Field 4A.
W90-01419

**ORIENTED COMPUTER APPROACHES OF NORMAL ERROR DISTRIBUTION.**
Agriculture and Water Resources Research Centre, Baghdad (Iraq). Dept. of Water Resources.
H. A. Hassan, and R. H. Hadi.
IN: Computer Methods and Water Resources: First International Conference, Morocco, 1988. Vol. 3, Computational Hydrology. Computational Mechanics Publications, Boston. 1988. p 117-129, 1 fig, 7 tab, 6 ref.

Descriptors: *Statistics, *Computer programs, *Computer models, *Hydrologic models, *Hydrologic properties, *Stochastic models, Probability distribution, Model studies, Mathematical models.

Two mathematical computerized models in basic and PL/I languages are presented as a direct solution for a normal probability distribution, which is widely used in hydrological problems. The first model (BETA), which represents a two-tail test, is dealing with the probability of non-exceedance. The output of this model is the area under the curve of normal distribution bounded between (-Z) and (+Z) standard scores. The second model, ALPHA, deals with the probability of exceedance, or the area under the tail of normal distribution curve bounded between (+Z) and infinity. The output of these models was tested for different values of Z and proved to be of highly significant fitability with the original values in standard tables. (See also W90-01409) (Author's abstract)
W90-01420

**TRANSFORMATION OF SURGE WAVES IN A WATER COURSE (TRANSFORMATION D'ONDES DE CRUE DANS UNE RETENUE).**
Gdansk Technical Univ. (Poland). Lab. of Hydraulic Construction.
For primary bibliographic entry see Field 8B.
W90-01421

**PREDICTION OF CYCLIC RAINFALL AND STREAMFLOW.**
University of the Witwatersrand, Johannesburg (South Africa). Water Systems Research Programme.
For primary bibliographic entry see Field 2B.
W90-01422

**URBAN HYDROLOGY PROCESSES AND MODELING.**
Purdue Univ., Lafayette, IN. School of Civil Engineering.
For primary bibliographic entry see Field 4C.
W90-01423

**STOCHASTIC METHODS AND RELIABILITY ANALYSIS IN WATER RESOURCES.**
Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
B. C. Yen.
IN: Computer Methods and Water Resources: First International Conference, Morocco, 1988. Vol. 3, Computational Hydrology. Computational Mechanics Publications, Boston. 1988. p 183-198, 1 fig, 3 tab, 15 ref.

Descriptors: *Stochastic process, *Stochastic models, *Hydrologic models, *Model studies, *Water management, *Rainfall-runoff relationships, Water conveyance, Flood forecasting, Rainfall impact, Hydrologic properties.

Considerable progress has been made in recent years on two of the probability based subjects in water resources. Many stochastic methods have been developed for data generation, forecasting and simulation. Likewise, new techniques have been proposed for comprehensive evaluation of the reliability of water systems, accounting for not only the occurrence frequency of rainfall or flood but also other contributing factors. A general view of stochastic methods and reliability analysis is presented. The methods of first-order second-moment risk analysis are recently developed, powerful tools for estimating the total or component risks of a system. (See also W90-01409) (Author's abstract)
W90-01424

**MODEL OF VECTOR TIME SERIES WITH BINARY COMPONENTS FOR APPLICATIONS IN CLIMATOLOGY (SUR UN MODELE DE SERIE CHRONOLOGIQUE VECTORIELLE A COMPOSANTES BINNAIRES EN VUE D'APPLICATIONS EN CLIMATOLOGIE).**
Mohammed-5 Univ., Rabat (Morocco). Dept. de Mathematiques.
For primary bibliographic entry see Field 2B.
W90-01425

**METHOD OF SELECTING SUBSET AUTOREGRESSIVE TIME SERIES MODELS.**
Tamkang Univ., Taipei (Taiwan). Dept. of Hydraulic Engineering.
G. H. Yu, and Y. C. Lin.
IN: Computer Methods and Water Resources: First International Conference, Morocco, 1988. Vol. 3, Computational Hydrology. Computational Mechanics Publications, Boston. 1988. p 219-230, 1 fig, 6 tab, 9 ref.

Descriptors: *Model studies, *Time series analysis, *Regression analysis, *Hydrologic models, Mathematical studies, Data processing, Data interpretation.

Recently, a wide class of subset autoregressive models, denoted by SAR in brief, has been proposed by several researchers. However, the estimation of subset autoregressive time series has been a difficult problem because of the large number of possible alternative models involved. The problem of identifying an appropriate subset autoregressive model to represent a time series, which may be a seasonal one, is considered. A diagnostic check for this model proposed by Hokstad, using the estimated cross correlation function between the observed series and the residuals, is modified and investigated. This method is used to study thousands of synthetic data as well as several real data. The results indicate that this method can successfully detect the true model for a given time series. (See also W90-01409) (Author's abstract)
W90-01426

**STOCHASTIC SIMULATION OF MONTHLY AVERAGE FLOW FOR RIVERS IN DRY OR SEMI-DRY CLIMATES (SIMULATION STOCHASTIQUE DE DEBITS MOYENS MENSUELS DANS LE CAS DE RIVIERES EN CLIMAT ARIDE OU SEMI-ARIDE).**
Universite Catholique de Louvain, Louvain-la-Neuve (Belgium). Faculte des Sciences Appliquees.
For primary bibliographic entry see Field 2E.
W90-01427

**METHODOLOGY FOR REAL-TIME FLOOD FORECASTING USING STOCHASTIC RAINFALL-RUNOFF MODELING.**
Ghent Rijksuniversiteit (Belgium). Lab. of Hydrology.
P. A. Troch, and F. P. De Troch.
IN: Computer Methods and Water Resources: First International Conference, Morocco, 1988. Vol. 3, Computational Hydrology. Computational Mechanics Publications, Boston. 1988. p 243-255, 10 fig, 3 tab, 7 ref.

Descriptors: *Model studies, *Stochastic models, *Rainfall-runoff relationships, *Flood forecasting, *Hydrologic models, Catchment areas, Geomorphology, Flood peak, Flood discharge, Runoff, Stochastic process, Statistical analysis, Dynamic programming, Model testing, Rainfall impact.

When faced with the problem of developing a real-time flood forecasting model, the geomorphological characteristics of the river basin that influence the system dynamics have to be considered. The geomorphological characteristics of the river Meuse at Liege, Belgium (basin area: approximately 20,000 sq km) are such that this river can be categorized as a pluvial river, in that during heavy rain, the water can rise to a high level in a very short time. These considerations concerning the dynamics of the catchment forces basing the real-time flood forecasting model largely on rainfall-runoff modeling. The methodology used to identify the rainfall-runoff relationship for several subcatchments of the river Meuse upstream Liege is described. A stochastic empirical approach is followed to obtain linear transfer function-noise (TFN) models. Model structure is characterized via statistical analysis (cross-correlation) and a more objective criterion, called BIC (Bayesian Information Criterion). The model parameters are estimated using the IV-AML algorithms (Instrumental Variable-Approximate Maximum Likelihood). The performance of this modeling technique is illustrated by two of the subcatchments under study, the Ourthe at Hamoir and the Less at Gendron. (See also W90-01409) (Author's abstract)
W90-01428

**STOCHASTIC MODELING OF THE DAILY FLOWS IN THE RIVER CRATI, SOUTHERN ITALY.**
Universita di Reggio Calabria, Cosenza (Italy).
For primary bibliographic entry see Field 2E.
W90-01429

**REGIONAL FLOOD DISTRIBUTION MODEL FOR SKEWED DATA.**
Pontificia Univ. Catolica de Chile, Santiago. Faculty of Engineering.
For primary bibliographic entry see Field 2E.
W90-01430

**EXTRAORDINARY INFORMATION IN PROBABILITY ESTIMATION METHOD OF FLOOD FREQUENCY ANALYSIS: MONTE CARLO RESULTS.**
Chengdu Univ. of Science and Technology (China). Dept. of Hydraulic Engineering.
Y. P. Zhang.
IN: Computer Methods and Water Resources: First International Conference, Morocco, 1988. Vol. 3, Computational Hydrology. Computational Mechanics Publications, Boston. 1988. p 287-306, 6 fig, 10 ref.

Descriptors: *Hydrologic data, *Flood frequency, *Flood forecasting, *Estimating equations, *Probability distribution, *Stochastic process, *Monte Carlo method, Mathematical studies, Probabilistic process, Precision.

A new definition of extraordinary information is given on the basis of the principle or probability estimation in flood frequency analysis suggested by the author. In consideration of the universal plotting position formula, which is unbiased in terms of probability direction, and the corresponding root-mean-square error of the exceedance probability estimates, it is pointed out that simulataneously making use of both extraordinarily large and small values with the proposed probability estimation method is frequency analysis will actually make the capacity of the original data information enlarged, and accordingly, the efficiency of probability estimates raised, playing a relatively substantial and balancing role for improving the accuracy of the result. It should be noted, however, that this generally plays an insignificant role for improving the efficiency of the parameter estimates. There is no good in improving unbiasedness of either parameter or probability estimates, especially in the case of putting the extraordinarily large in use only. Therefore, it is suggested to reveal in practice the order information hidden by all of the extraordinary information, including both high and low, making use of them in probability estimation method of frequency analysis. (See also W90-01409) (Author's abstract)
W90-01431

**EFFECTS OF WHOLE-TREE CLEARCUTTING ON STREAMFLOW CAN BE ADEQUATELY ESTIMATED BY SIMULATION.**
Northeastern Forest Experiment Station, Durham, NH. Forestry Sciences Lab.
For primary bibliographic entry see Field 2E.
W90-01485

**SIMULATION OF EFFECTS OF FOREST GROWTH ON WATER YIELD WITH A DYNAMIC PROCESS-BASED USER MODEL.**
Natal Univ., Pietermaritzburg (South Africa). Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 4C.
W90-01486

**EXTRAPOLATION OF RESEARCH RESULTS BY DETERMINISTIC MODELS.**
Warsaw Univ. (Poland). Faculty of Geography and Regional Studies.
For primary bibliographic entry see Field 2A.
W90-01487

**SIMULATION OF WATER FLOW AND SOIL EROSION PROCESSES WITH A DISTRIBUTED PHYSICALLY-BASED MODELLING SYSTEM.**
Dansk Hydraulisk Inst., Hoersholm.
For primary bibliographic entry see Field 2J.
W90-01488

**ANALYSIS OF STORMFLOW AND ITS SOURCE AREA EXPANSION THROUGH A SIMPLE KINEMATIC WAVE EQUATION.**
Forest and Forest Products Research Inst., Kyoto (Japan). Kansai Branch.
For primary bibliographic entry see Field 2A.
W90-01489

**RUNOFF VARIABILITY: A GLOBAL PERSPECTIVE.**
Melbourne Univ., Parkville (Australia). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W90-01538

**EVALUATION OF RUNOFF CHANGES IN THE LABE RIVER BASIN BY SIMULATING THE PRECIPITATION-RUNOFF PROCESS.**
Ceskoslovenska Akademie Ved, Prague. Hydrometeorological Inst.
For primary bibliographic entry see Field 2E.
W90-01543

**PALEOHYDROLOGIC STUDIES USING PROXY DATA AND OBSERVATIONS.**
Bundesanstalt fuer Gewaesserkunde, Koblenz (Germany, F.R.).
For primary bibliographic entry see Field 2A.
W90-01547

**LONG WATER BALANCE TIME SERIES IN THE UPPER BASINS OF FOUR IMPORTANT RIVERS IN EUROPE--INDICATORS FOR CLIMATIC CHANGES.**
Service Hydrologique National, Bern (Switzerland).
For primary bibliographic entry see Field 2A.
W90-01556

**ANALYSIS OF PATTERNS IN A PRECIPITATION TIME SEQUENCE BY ORDINARY KALMAN FILTER AND ADAPTIVE KALMAN FILTER.**
Kyushu Univ., Fukuoka (Japan). Dept. of Hydraulic Civil Engineering.
For primary bibliographic entry see Field 2B.
W90-01557

**IDENTIFICATION OF RECENT RAINFALL FLUCTUATIONS IN THE PHILIPPINES.**
Kyushu Univ., Fukuoka (Japan). Dept. of Hydraulic Civil Engineering.
For primary bibliographic entry see Field 2B.
W90-01558

**CONSISTENT PARAMETER ESTIMATION IN A FAMILY OF LONG-MEMORY TIME SERIES MODELS.**
Purdue Univ., Lafayette, IN. School of Civil Engineering.
A. R. Rao, and G.-H. Yu.
IN: The Influence of Climate Change and Climatic Variability on the Hydrologic Regime and Water Resources, International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication No. 168, 1987. p 245-253, 3 fig, 2 tab, 6 ref.

Descriptors: *Statistics, *Statistical methods, *Time series analysis, *Estimating, Mathematical models, Least squares method, Spectral analysis.

Two approaches have been proposed for estimation of parameters in fractional difference models. The first estimator is based on the least squares method in the frequency domain. This estimator is unbiased and consistent in the mean square sense. The second estimator is based on the spectral characteristics of the model. These two estimators are compared. The least-squares parameter estimation method is recommended. The reason for this choice is that it avoids the use of ad-hoc assumptions inherent in estimation of spectra and is much simpler to use. (See also W90-01537) (Shidler-PTT)
W90-01559

**TEMPORAL DISAGGREGATION OF MONTHLY RAINFALL DATA FOR WATER BALANCE MODELLING.**
Hawaii Univ. at Manoa, Honolulu. Dept. of Geography.
For primary bibliographic entry see Field 2B.
W90-01560

**SPACE-TIME MODELLING OF RAINFALL-RUNOFF PROCESS.**
Ottawa Univ. (Ontario). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2B.
W90-01561

**FOURIER-ARIMA MODELLING OF THE MULTIANNUAL FLOW VARIATION.**
Cluj-Napoca Univ. (Romania). Dept. of Geography.
For primary bibliographic entry see Field 2E.
W90-01562

**MODELING A NON-STATIONARY PROCESS--APPLICATION TO THE RAINFALL DATA IN SEMI-ARID AREAS, (MODELISATION D'UN PROCESSUS NON-STATIONNAIRE--APPLICATION A LA PLUVIOMETRIE EN ZONE SEMI-ARIDE).**
Ecole Polytechnique Federale de Lausanne (Switzerland). Inst. de Genie Rural.
A. Musy, and P. Meylan.
IN: The Influence of Climate Change and Climatic Variability on the Hydrologic Regime and Water Resources, International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication No. 168, 1987. p 287-299, 8 fig, 13 ref. English summary.

Descriptors: *Climatology, *Rainfall variability, *Model studies, *Meteorological data collection, *Semiarid lands, Time series analysis, Design criteria, Burkina Faso, Sahel.

The persistence of a rainfall deficit in the Sahelian area for 15 yrs lead to doubts about the legitimacy of the classical methods for the design of construction works. Time series showed an unstationary behavior. A technique is proposed for the modeling of a nonstationary process which is applied to the rainfall data of Burkina-Faso. The knowledge of the regional climatic trend, whose future evolution is uncertain, is required for the use of this model for the design of construction works. Some possibilities for facing that difficult problem are outlined. (See also W90-01537) (Author's abstract)
W90-01563

**MACROSCALE HYDROLOGIC MODELS IN SUPPORT TO CLIMATE RESEARCH.**
Institut fuer Wasserwirtschaft, Berlin (German D.R.).
For primary bibliographic entry see Field 2A.
W90-01574

**UNSATURATED FLOW IN HYDROLOGIC MODELING: THEORY AND PRACTICE.**
For primary bibliographic entry see Field 2G.
W90-01590

**BACKGROUND CONCEPTS AND PRINCIPLES.**
Louvain Univ. (Belgium).
For primary bibliographic entry see Field 2G.
W90-01591

**MULTIPHASE FLOW IN POROUS MEDIA: DESCRIPTION AT THE PORE AND MACROSCOPIC SCALE.**
Thessaloniki Univ., Salonika (Greece). Lab. of Hydraulics and Hydraulic Works.
For primary bibliographic entry see Field 2G.
W90-01592

**INFILTRATION AND PONDING.**
New York State Coll. of Agriculture and Life Sciences, Ithaca. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 2G.
W90-01594

**NUMERICAL SIMULATION OF RICHARDS EQUATION: CURRENT APPROACHES AND AN ALTERNATE PERSPECTIVE.**
California Univ., Berkeley. Earth Sciences Div.
For primary bibliographic entry see Field 2G.
W90-01602

**LOSS RATE REPRESENTATION IN THE HEC-1 WATERSHED MODEL.**
Hydrologic Engineering Center, Davis, CA.
For primary bibliographic entry see Field 2A.
W90-01603

**COMPARATIVE EVALUATION OF UNSATURATED FLOW METHODS IN SELECTED USDA SIMULATION MODELS.**
Agricultural Research Service, Fort Collins, CO.

For primary bibliographic entry see Field 2G.
W90-01604

**UNSATURATED COMPONENTS OF SWATCH: A MULTIPROCESS WATERSHED MODEL FOR RUNOFF GENERATION AND ROUTING.**
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2G.
W90-01605

**SPATIALLY DISTRIBUTED MODELLING: CONCEPTUAL APPROACH, COUPLING SURFACE WATER AND GROUNDWATER.**
Ecole Nationale Superieure des Mines de Paris, Fontainebleau (France). Centre d'Information Geologique.
E. Ledoux, G. Girard, and G. de Marsily.
IN: Unsaturated Flow in Hydrologic Modeling: Theory and Practice. Kluwer Academic Publishers, Boston. 1989. p 435-454, 13 fig, 2 tab, 35 ref.

Descriptors: *Soil water, *Model studies, *Surface-groundwater relations, Groundwater movement, Streamflow, Surface flow, Aeration zone, Unsaturated flow, Water table, Aquifers, Soil water, Hydrographs, Coupled model, Caramy watershed, France.

The joint modeling of surface and groundwater flows is examined by presenting and describing the MC (coupled model) model. The purpose of this deterministic physically-based model is to simulated the behavior of available water resources for one or several watershed. The model integrates surface flow, streamflow, flow in the unsaturated zone, groundwater flow and the interactions between rivers and water tables. Its formulation and its structure, especially its nested square meshes of variable sizes, give a great deal of flexibility to the model; this facilitates adaptation to variable modeling scales and to a wide range of geological, geographical and climatological conditions. An application of the MC model on the Caramy watershed in France is illustrated. (See also W90-01590) (Author's abstract)
W90-01606

**MULTI-PURPOSE, MULTI-RESERVOIR SIMULATION ON A PC.**
Hydrologic Engineering Center, Davis, CA.
For primary bibliographic entry see Field 2H.
W90-01725

**MONTHLY RESULTS OF MEASUREMENTS, JULY 1987 (TABLEAUX MENSUELS DES MESURES).**
For primary bibliographic entry see Field 5B.
W90-01731

**MULTICOMPARTMENT MODEL OF SUSPENDED MATTER TRANSPORT IN SURFACE BODIES OF WATER (MULTIKOMPARTIMENT-MODELL FUR DEN TRANSPORT VON STOFFEN IN OBERFLAECHENGEWAESERN).**
Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.). Projektgruppe Umweltgefaehrdungspontenziale von Chemikalien.
For primary bibliographic entry see Field 5B.
W90-01775

**SUPRA-NATIONAL MAPPING OF ENVIRONMENTAL NUISANCES BY POLLUTANTS (UEBERREGIONALES KATASTER DER SCHADSTOFFBELASTUNG DES BODENS).**
Umweltbundesamt, Berlin (Germany, F.R.).
For primary bibliographic entry see Field 5A.
W90-01790

**DETERMINATION OF THE ACCURACY OF WATER LEVEL OBSERVATIONS.**
Rijkswaterstaat, The Hague (Netherlands).
For primary bibliographic entry see Field 7B.
W90-01812

**PARAMETERIZATION OF SNOW ALBEDO FOR CLIMATE MODELS.**
Cooperative Inst. for Research in Environmental Science, Boulder, CO.
For primary bibliographic entry see Field 2C.
W90-01854

**METHOD FOR INDEXING THE VARIABILITY OF ALPINE SEASONAL SNOW OVER LARGE AREAS.**
Otago Univ., Dunedin (New Zealand). Dept. of Geography.
For primary bibliographic entry see Field 2C.
W90-01863

**MODELLING LARGE SCALE EFFECTS OF SNOW COVER.**
British Columbia Univ., Vancouver.
For primary bibliographic entry see Field 2C.
W90-01864

**MODELLING THE EFFECTS OF AGROTECHNICAL MEASURES ON SPRING RUNOFF AND WATER EROSION.**
Akademiya Nauk SSSR, Moscow. Inst. Vodnykh Problem.
For primary bibliographic entry see Field 2C.
W90-01871

**SIMPLE SNOWPACK STRUCTURE MODEL AND ITS APPLICATION TO MOUNTAIN SNOWPACK PROBLEMS.**
California State Univ.-San Bernadino. Dept. of Geography.
For primary bibliographic entry see Field 2C.
W90-01873

**ANALYSIS OF INTERANNUAL VARIATIONS OF SNOW MELT ON ARCTIC SEA ICE MAPPED FROM METEOROLOGICAL SATELLITE IMAGERY.**
Lamont-Doherty Geological Observatory, Palisades, NY.
For primary bibliographic entry see Field 2C.
W90-01877

**SNOW COVER PARAMETER RETRIEVAL FROM VARIOUS DATA SOURCES IN THE FEDERAL REPUBLIC OF GERMANY.**
Cooperative Inst. for Research in Environmental Science, Boulder, CO.
For primary bibliographic entry see Field 2C.
W90-01880

**INTEGRATION OF DIGITAL TERRAIN MODELS INTO GROUND BASED SNOW AND RUNOFF MEASUREMENT.**
Saskatchewan Research Council, Saskatoon.
For primary bibliographic entry see Field 2C.
W90-01882

**CLASSIFICATION MODEL FOR SPATIAL ESTIMATION OF SNOWPACK VARIABLES FROM SATELLITE DATA.**
Utah State Univ., Logan.
For primary bibliographic entry see Field 2C.
W90-01883

**DISTRIBUTION OF SNOW EXTENT AND DEPTH IN ALASKA AS DETERMINED FROM NIMBUS-7 SMMR MAPS (1982-83).**
National Aeronautics and Space Administration, Greenbelt, MD. Goddard Space Flight Center.
For primary bibliographic entry see Field 2C.
W90-01884

**SLIDING OF COLD ICE SHEETS.**
Laboratoire de Glaciologie et Geophysique de l'Environnement, Saint-Martin d'Heres (France).
For primary bibliographic entry see Field 2C.
W90-01898

**EFFECTS OF GLACIAL EROSION ON THE FLOW OF ICE SHEETS AND MORPHOLOGY OF THEIR BEDS.**
Akademiya Nauk SSSR, Moscow. Inst. Geografii.
For primary bibliographic entry see Field 2C.
W90-01899

**EFFECT OF CREVASSES ON THE SOLAR HEATING OF A GLACIER SURFACE.**
Washington Univ., Seattle. Geophysics Program.
For primary bibliographic entry see Field 2C.
W90-01903

**SIMPLE SIMULATION OF ICE-ATMOSPHERE-OCEAN-LAND COUPLING IN CLIMATIC MODELS.**
National Center for Atmospheric Research, Boulder, CO.
For primary bibliographic entry see Field 2C.
W90-01908

**USE OF TRACE CONSTITUENTS TO TEST FLOW MODELS FOR ICE SHEETS AND ICE CAPS.**
Department of Energy, Mines and Resources, Ottawa (Ontario). Polar Continental Shelf Project.
For primary bibliographic entry see Field 2C.
W90-01911

# 8. ENGINEERING WORKS

## 8A. Structures

**ROLLCRETE GRAVITY DAMS AND METHODS OF ITS TIERED CONSTRUCTION.**
E. A. Kogan, and V. I. Sakharov.
Hydrotechnical Construction HYCOAR, Vol. 22, No. 11, p 627-632, May 1989. 5 fig. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 11, p 9-13, November 1988.

Descriptors: *Hydraulic structures, *Hydraulic engineering, *Dams, *Rollcrete, *Concretes, *Gravity dams, *Construction materials, Earthworks, Construction, Design criteria.

Recently, the tiered method of concreting massive dams has been gaining increasingly more recognition owing to the high mechanization of the main intrablock operations and the possibility of changing to a sectional system of division. The latter makes it possible to dispense with pipe cooling and grouting of joint and substantially reduces the volume of formwork operations. Further progress on the path of simplifying works related to regulating the temperature regime can be made by means of roller-compacted, low cement (lean) concrete. One of the main problems is the development of such a rollcrete design gravity dam in which it would be possible to most completely realize the advantages of lean rollcrete as a material and the technological advantages created by the tiered scheme of constructing dams with sectional division. A solution for the design of the dam and a method for its construction is presented. To eliminate the joint between the upstream zone of ordinary concrete and internal zone of rollcrete, a gravity dam design is proposed with the construction of a sawtooth joint between these zones, which is obtained by tiered placement, first of 2-4 layers of rollcrete, then concrete in the upstream zone with the use of the layerwise method. On the downstream face, protection of the rollcrete is suggested with an insulating layer made of triangular precast reinforced concrete elements, inside of which is the insulation. The tiered installation of the precast elements with rolling of 2-4 layers of lean concrete on them creates the sawtooth joint between the internal and downstream zone of the dam, allowing minimal effect of outside air temperature fluctuations on the load-bearing profile of the structure. The proposed dam design allows uniform tiered placement of the concrete. (Friedmann-PTT)
W90-01197

**GROUNDWATER LOWERING IN THE FOUNDATION PIT OF THE KAISIADORYS PUMPED-STORAGE STATION.**
V. A. Nepomnyashchii, V. Y. Akishin, L. A. Titov, and D. N. Shepilov.
Hydrotechnical Construction HYCOAR, Vol. 22, No. 11, p 632-638, May 1989. 6 fig, 1 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 11, p 13-17, November 1988.

Descriptors: *Hydraulic structures, *Groundwater level, *Construction methods, *Hydraulic engineering, *Groundwater management, *Pumped storage, USSR, Penstocks, Pumps, Wellpoints, Wells, Hydraulic head.

The groundwater lowering works at the construction of the Kaisiadorys pumped-storage station (PSS) (U.S.S.R.), from the start of constructing the concrete bed for the powerhouse of the PSS up to the completion of the construction of the blanket and lower sections of the pile field penstocks, is examined. The system includes 64 wells with submersible pumps along the contour of the pit on the berm from an elevation of 153 m and on the cofferdam from an elevation of 146.5 m; four levels of LIU-6BM wellpints at elevations of 131, 127, 124, and 122.5 m; a circular open drainage trench at the contact of the Quaternary deposits and siltstones, equipped with two pumping stations, and in the siltstones, three levels of UVV-3-6KM vacuum wellpoints at elevations of 114.5, 110.5, and 108.5 m. The total number of wellpoints installed was 22. Since the head developed by the pump unit was 20 m, the water was discharged from these wellpoints into the circular open drainage trench at an elevation of 122.5 m. Through operation and reconstruction of the groundwater-lowering system during backfilling in the pit and construction of the powerhouse permit, it was concluded that the measures specified by the design on reconstructing the groundwater-lowering system in the pit reliably provided the performance of construction and installation works on constructing the powerhouse and penstocks. Under the foundation slab of the PSS powerhouse, a horizontal drainage system is recommended to allow maximum possible inflow, which would serve to prevent subirrigation of the pit by rainwaters and water table rise as a result of unforeseen disconnection of the groundwater-lowering equipment. (Friedmann-PTT)
W90-01198

**DAMMING OF THE IRTYSH RIVER AT THE CONSTRUCTION SITE OF THE SHUL'BINSK HYDROELECTRIC STATION.**
V. S. Panteleev, R. F. Gorlatov, and V. S. Kolesnik.
Hydrotechnical Construction HYCOAR, Vol. 22, No. 11, p 638-642, May 1989. 3 fig, 2 tab. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 11, p 18-21, November 1988.

Descriptors: *Dams, *Dam construction, *Hydraulic structures, *Hydroelectric plants, *Design criteria, *Hydraulic engineering, USSR, Hydraulic properties, Drainage areas, Streamflow, Hydrological regime.

The Irtysh River, the largest tributary of the Ob River (U.S.S.R.), originates on the southern slopes of the Altai. The total length of the Irtysh is 4248 km, and the drainage area is 1,643,000 sq km. The site of the Shul'binsk hydroelectric station is located in the middle course of the Irtysh River. The design of the hydrostation and the hydraulic characteristics of its interaction with the Irtysh River is reviewed, as is the planning and design criteria of the damming of the river at the hydroelectric site. By September 1987, the main preparatory works of damming the channel and diversion of the water through concrete structures had been performed at the construction site of the Shul'binsk hydrostation. The hydrological conditions on the stretch of the hydrostation site at the start of works on damming were distinguished by a smooth variation of the stages and discharges. The range of variation of water levels in the first decade of September did not exceed 0.12 m, and the water discharges varied between 665 and 725 cu m/sec, which created favorable conditions for performing works on damming the river. The final stage of damming of the Irtysh River was carried out without complications, which was promoted by the favorable regime provided by streamflow regulation by the Bukhtarma and Ust'-Kamenogorsk reservoirs. The upstream and downstream cofferdams of the pit of the first phase after their opening were subjected to intense self-erosion for several hours, and then were dismantled by excavators and a dredge. Good dismantling of the cofferdams provided their high discharge capacity, as a consequence of which the differences of water levels and current velocities in the gap of the embankment began to decrease. In the final stage of damming, the maximum velocities did not exceed 3.5 m/sec with a discharge of 73.8 cu m/sec. The inflow discharge was 665 cu m/sec and the final drop on the embankment was 0.67 m. (Friedmann-PTT)
W90-01199

**ARCHITECTURE OF THE TOKTOGUL HYDROELECTRIC STATION ON THE NARYN RIVER.**
E. S. Matveev.
Hydrotechnical Construction HYCOAR, Vol. 22, No. 11, p 643-647, May 1989. 4 fig. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 11, p 21-24, November 1988.

Descriptors: *Hydroelectric plants, *Hydroelectric power, *Hydraulic structures, *Architecture, *Design criteria, *Hydrological regime, USSR, Dams, Hydraulic engineering.

The architecture of the Toktogul hydrostation, constructed on the Naryn River in the Kirgiz S.S.R., is reviewed. The hydrostation is intended for the combined solution of economic problems, which promote the further development of the productive forces of Kirgiz and adjacent republics: streamflow regulation by the Toktogul reservoir will make it possible to increase electric power production in the cascade of downstream hydrostations, and will provide guaranteed irrigation of existing irrigated as well as virgin and fallow lands of the fertile Fergana Valley. The architecture of the Toktogul hydrostation is distinguished by profound individuality. On the basis of technological expediency, the dam and powerhouse are united into a common monoblock, which fostered high industrialization of construction, shortened the length of service lines, and created the maximum possible conveniences of the operating personnel. Clarity of the composition is characteristic for structure of the hydro development, as represented by the concrete gravity dam with a construction height of 215 m. Directly abutting the dam on the downstream side, the powerhouse forms with it a compact system of coordinated bodies, and in combination with the outlet works uniting this system, a single architectural ensemble is created. From the lower pool, the majesty and coordination of sizes and shapes is striking. The dam and powerhose are designed integrally, with large and distinct articulations commensurate with the natural surroundings. The leading role in the composition is the largest volume of the dam, with a longitudinal axis and central section that offset the lower pool. The development of the theme of a strong concrete dam in the architectural treatment of the Toktogul hydrostation was emphasized by the chutes of the spillways resting on its downstream face and on the strong pylons of the powerhouse facade. The monumental structure with its large forms subordinate to a single compositional idea blended harmoniously into the mountain landscape. (Friedmann-PTT)
W90-01200

**HYDRAULIC CALCULATION OF FREE-FLOW EDDY SPILLWAYS.**
For primary bibliographic entry see Field 7C.
W90-01201

**CRITERIA FOR DAM SAFETY.**
L. A. Zolotov, I. N. Ivashchenko, and A. I. Tsarev.
Hydrotechnical Construction HYCOAR, Vol. 22, No. 11, p 659-663, May 1989. 1 fig, 1 tab, 11 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 11, p 33-37, November 1988.

Descriptors: *Dams, *Dam construction, *Hydraulic structures, *Earthworks, *Safety, *Dam stability, Damage, Hydraulic design, Monitoring, Hydraulic systems.

A dam is a element of the single 'dam-foundation-reservoir' system. The safety of the dam can be determined by taking into account the interaction of elements of the indicated system, for example: body of the dam, foundation and abutments of the dam, and reservoir and outlet works. A system for the evaluation of the safety of hydraulic structures is presented. A generalized index of the degree of damage of the system is formulated. Each of the elements of the system has it own structure. As a result, a hierarchical structure of the dam--foundation-reservoir system--can be constructed. The index of the degree of damage of each element of the system is either calculated by the developed formula or is determined on the basis of a special analysis and, ultimately, characterizes the degree of deviation of the state of a given element from conditions providing maximum safety. An evaluation of the state of the elements of the system can be made on the basis of measurements using a system of measuring and monitoring instruments, as well as on the basis of the data of visual observations and calculations. Among the indices that can be monitored are movements and characteristics of cracks in the body and foundation of the dam and abutment zones, stresses in the dam and foundation, temperature gradients, dynamic response of the dam, seepage discharge in various sections of the dam, characteristics of the slide zones, and state of the outlet work, gate equipment, and revetments. This method is applied to a channel stretch with a length of 7 km and sand hydraulic-fill dam with a height of 30 m. The geodetic observations established an increase of the rate of settlement of the dam crest, which correlated in time with boosting of the upper pool level and with an increase of railraod freight traffic along the dam crest. The visual inspection of the wave-protecting revetments of the upstream slope revealed damage to the reinforced-concrete slabs. Calculation of the generalized state of damage of the dam was carried out for all sections of the dam with respect to all types of limit states. The generalized characteristic of the state of the entire dam is obtained by averaging the indices of damage calculated for individual sections. (Friedmann-PTT)
W90-01204

**SEALING DEVICE FOR WIDE EXPANSION JOINTS.**
For primary bibliographic entry see Field 8G.
W90-01208

**WATER BENEATH THE CITY STREETS.**
Moretrench American Corp., Rockaway, NJ.
For primary bibliographic entry see Field 4B.
W90-01267

**RUBBLE-MOUND BREAKWATERS WITH S-SHAPE DESIGN.**
Middle East Technical Univ., Ankara (Turkey). Dept. of Civil Engineering.
A. Ergin, A. R. Gunbak, and A. M. Yanmaz.
Journal of Waterway, Port, Coastal and Ocean Engineering (ASCE) JWPED5, Vol. 115, No. 5, p 579-593, September 1989. 11 fig, 3 tab, 9 ref, append.

Descriptors: *Breakwaters, *Slope stability, *Berms, *Wave action, Wave height, Rocks, Equilibrium, Water depth, Volumetric analysis, Design criteria, Civil engineering, Structural engineering.

When a single-slope, rubble-mound breakwater is subjected to waves that dislocate the stones but do not cause any overtopping, the damaged section may become stabilized at a certain level of wave attack, generating the 'S-shaped equilibrium profile.' A further increase in wave height finally causes a complete damage of the breakwater. If an equilibrium profile of a rubble-mound breakwater section is examined, it is observed that the resulting

profile is similar to a three-slope berm-type section. The fact that an equilibrium profile of a rubble-mound breakwater is reached under the attack of waves greater than the design wave brings the consideration of constructing the rubble-mound breakwaters to equilibrium profiles initially, which may lead to the use of smaller armor units. To study this problem, a series of tests on a single, sloped (1:2) rubble-mound breakwater section, constructed at a constant water depth, are carried out with regular waves in the laboratory. Under the same test conditions, i.e., same wave height, period range, water depth, and same armor stone size, the three-slope berm-type section produces up to 90% less damage relative to the 1:2 single-slope section. Volumetric comparison shows that three-slope berm-type sections have less or comparable volumes to the 1:2 single-slope section, due to reduced wave run-up. (Author's abstract)
W90-01340

**KIAMBERE HYDROELECTRIC PROJECT, KENYA: PART 2. DESIGN.**
For primary bibliographic entry see Field 8C.
W90-01355

**REVISED GROUND SNOW LOADS FOR THE 1990 NATIONAL BUILDING CODE OF CANADA.**
Canadian Climate Centre, Downsview (Ontario).
For primary bibliographic entry see Field 2C.
W90-01364

**HYDROLOGIC DESIGN CRITERIA AND CLIMATE VARIABILITY.**
Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.
R. A. Clark.
IN: The Influence of Climate Change and Climatic Variability on the Hydrologic Regime and Water Resources, International Association of Hydrological Sciences Press, Institute of Hydrology, Wallingford, Oxfordshire, UK. IAHS Publication No. 168, 1987. p 545-551, 2 tab, 14 ref.

Descriptors: *Climatology, *Dam failure, *Dam construction, Precipitation, Design criteria, Reservoirs, Floods, Hydrology.

The importance of designing for rare events has been emphasised by the failure of a rather large number of dams over the last century and the effects of climate change on hydrologic design criteria for flood events is an important aspect. In particular, change could impact the magnitude of Probable Maximum Precipitation estimates easily by 10 to 20%. Such increases would in turn, severely affect the design of large reservoirs. Climatic change effects of moderate frequency floods are also discussed, and a review of current literature and concepts is presented. (See also W90-01537) (Author's abstract)
W90-01583

**FLOOD PROTECTION IN THE LOWER RHINE BASIN.**
Staatliches Amt fuer Wasser- und Abfallwirtschaft, Duesseldorf (Germany, F.R.).
W. Schmitz.
IN: Hydrological Processes and Water Management in Urban Areas. Proceedings of the International Symposium 24-29 April 1988, Duisburg, West Germany. International Hydrological Programme of UNESCO Publication, 1988. p 351-356, 4 fig, 1 tab.

Descriptors: *Leaves, *Flood protection, *Rhine River, *Dikes, *West Germany, Flood discharge, Flood peak, Coal mining, Subsidence.

Flood protection was, is, and remains a prior condition for the development of the Lower Rhine as a residential and industrial site. Flood protection in the North Rhine Watershed--Westphalia (NW) is carried out autonomously under state supervision by the persons affected. The flood (high water=HW) of 1925/26 has been determined as the event with the highest discharge on the Lower Rhine. This water flow made it necessary to raise the dikes which in general were 1 m above peak water level. Flood protection in the area of Greater Duisburg for decades includes the problem of subsidences. Due to underground coal mining, a subsidence trough is formed at the surface. In the middle of the trough regular subsidences occur, while at the edges there are compressions, inclinations and deformations. Subsidences due to mining change the static earth conditions not only at the dikes, but also in the near and distant environment. Four examples of dike construction measures required as a result of mining are presented illustrating that dikes designed on the basis of events occurring very seldom, requirements for the condition of the dikes are high, e.g. regular controls, as they must at any time guarantee safety for the design discharge. (See also W90-01612) (Lantz-PTT)
W90-01651

**AQUEDUCT AND VIADUCT: HOW THE RIVER NAHE BECAME MAINSTREET OF IDAR-OBERSTEIN.**
Technische Hochschule Darmstadt (Germany, F.R.). Inst. fuer Wasserbau.
For primary bibliographic entry see Field 4A.
W90-01682

**CHALLENGES OF WATER SUPPLY DEVELOPMENT IN THE URBANISED ISLAND OF PENANG, MALAYSIA.**
Brunei Univ., Bandar Seri Begawan. Dept. of Geography.
For primary bibliographic entry see Field 3D.
W90-01685

**FLOOD PROTECTION PLANTS OF THE CITY OF WASSERBURG A. INN.**
Wasserwirtschaftsamt Rosenheim (Germany, F.R.).
For primary bibliographic entry see Field 4C.
W90-01687

**DEFINITE PROJECT REPORT FOR SECTION 14 EMERGENCY STREAMBANK PROTECTION: NORTH RACOON RIVER, IOWA STATE HIGH 7 BRIDGE IN BUENA VISTA COUNTY, IOWA.**
Army Engineer District, Rock Island, IL.
For primary bibliographic entry see Field 4D.
W90-01713

**SEVERAL PROBLEMS OF DAM CONSTRUCTION BY DIRECTIONAL BLASTING.**
Institute of Water Conservancy and Hydroelectric Power Research, Beijing (China).
For primary bibliographic entry see Field 8H.
W90-01720

**DETERMINATION OF FUNDAMENTAL DESIGN PARAMETERS OF IRRIGATION AND DRAINAGE SYSTEMS BY MEANS OF MATHEMATICAL MODELLING OF SOIL-WATER REGIME.**
Slovenska Akademia Vied, Bratislava (Czechoslovakia). Ustav Hydrologie a Hydrauliky.
For primary bibliographic entry see Field 3F.
W90-01831

## 8B. Hydraulics

**PREDICTION OF CAVITATION AS A FUNCTION OF WATER NUCLEI CONTENT AND HYDRODYNAMIC CONDITIONS (CASE OF THE FLOW AROUND A TWO-DIMENSIONAL HYDROFOIL) (LA PREVISION DE LA CAVITATION EN FONCTION DE L'ETAT DE NUCLEATION DE L'EAU ET DES CONDITIONS HYDRODYNAMIQUES (CAS DE L'ECOULEMENT AUTOUR D'UNE AILE BIDIMENSIONNELLE)).**
Institut de Mecanique de Grenoble, Saint-Martin d'Heres (France).
L. Briancon-Marjollet, J. P. Franc, and J. M. Michel.
La Houille Blanche HOBLAB, Vol. 5, No. 6, p 495-500, 1988. 2 fig, 1 tab, 4 ref. English summary.

Descriptors: *Cavitation, *Fluid mechanics, *Flow around objects, Viscosity, Hydrofoils, Bubbles.

Tests have been performed in the hydrodynamic tunnel of 'Institut de mecanique de Grenoble' to investigate the coupled effects of nuclei and viscosity on cavitation. Several water nuclei contents were tested by injecting air microbubbles in variable quantities upstream of the test section. The spectra of injected cavitation nuclei, characterized by a histogram of critical pressures, was measured by means of a venturi. The influence of the water nuclei content was analyzed for different types of boundary layers obtained by varying the angle of attack of a two-dimensional Naca 16209 hydrofoil: laminar separation, transition boundary layer, turbulent boundary layer, laminar separation bubble. For each configuration, the conditions of inception of cavitation and the type of cavitation which develops--travelling bubbles or attached cavity--was studied as a function of the water quality. The transition from an attached cavity to travelling bubble cavitation which may occur when the nuclei concentration exceeds a critical value was also studied. Several rapid films permitted the detailed analysis of the influence of nuclei explosion on the boundary layer and on the cavity and the identification of the physical mechanisms responsible for the transition from one type of cavitation to the other one. All these tests make it possible to predict the conditions of inception and development of cavitation on a two-dimensional hydrofoil as a function of the water nuclei content and the hydrodynamic conditions, and particularly of the state of the boundary layer which develops on the foil. (Author's abstract)
W90-01141

**RECENT RESEARCH RELATING TO CAVITATION CARRIED OUT AT THE GRENOBLE INSTITUTE OF MECHANICS (RECHERCHES RECENTES SUR LA CAVITATION A L'INSTITUT DE MECANIQUE DE GRENOBLE).**
Institut de Mecanique de Grenoble, Saint-Martin d'Heres (France).
J. M. Michel.
La Houille Blanche HOBLAB, Vol. 5, No. 6, p 517-526, 1988. English summary.

Descriptors: *Fluid mechanics, *Cavitation erosion, Hydrodynamics.

Two cavitation test methods are discussed: the developed cavitation studied in the IMG's hydrodynamic tunnel, and cavitation erosion studied on a mercury loop. The developed cavitation study includes: an analysis relating to the separation of a cavity from a wall, the unsteady cavitation per pocket, the boundary layer and the cavity and an experimental study of partial cavitation. Cavitation erosion tests were performed to clarify the rules of similarity. A special effort has been made to develop and calibrate miniaturized pressure sensors specially adapted to measure instantaneous excess pressures due to structural implosion. (Author's abstract)
W90-01142

**HYDRAULIC CALCULATION OF FREE-FLOW EDDY SPILLWAYS.**
For primary bibliographic entry see Field 7C.
W90-01201

**RUBBLE-MOUND BREAKWATERS WITH S-SHAPE DESIGN.**
Middle East Technical Univ., Ankara (Turkey). Dept. of Civil Engineering.
For primary bibliographic entry see Field 8A.
W90-01340

**STEM WAVES ALONG BREAKWATER.**
Cornell Univ., Ithaca, NY. School of Civil and Environmental Engineering.
S. B. Yoon, and P. L.-F. Liu.
Journal of Waterway, Port, Coastal and Ocean

Engineering (ASCE) JWPED5, Vol. 115, No. 5, p 635-648, September 1989. 11 fig, 1 tab, 12 ref.

Descriptors: *Wave propagation, *Breakwaters, *Wave refraction, Numerical analysis, Stokes law, Wave height, Mathematical models.

Waves propagated along breakwaters have been divided into three types: the incident wave, the reflected wave, and a wave propagating along the wall called the stem wave. Numerical computations based on Boussinesq equations and parabolic approximation are carried out to examine the development of stem waves along a straight breakwater due to incident cnoidal waves, and the forward diffraction of cnoidal waves by a straight breakwater. It is demonstrated numerically that stem waves can be generated along a straight breakwater by an incident cnoidal wave train. The characteristics of the stem wave are similar to those generated by second-order Stokes waves. Namely, the stem waves propagate along the breakwater with a more or less uniform wave amplitude. The amplitude of stem waves decreases as the nonlinearity of the incident waves increases. The amplitude of stem waves also decreases as the angle between the incident waves and breakwater becomes smaller. The width of the stem waves seem to become more linear in the direction of wave propagation. A numerical method for obtaining uniform cnoidal waves produces cnoidal waves in a permanent form and is consistent with the parabolic approximation used in the diffraction studies. (Fish-PTT)
W90-01342

**HYDRAULICS OF CULVERT FISHWAYS II: SLOTTED-WEIR CULVERT FISHWAYS.**
Alberta Univ., Edmonton. Dept. of Civil Engineering.
N. Rajaratnam, C. Katopodis, and N. McQuitty.
Canadian Journal of Civil Engineering CJCEB8, Vol. 16, No. 3, p 375-383, June 1989. 9 fig, 1 tab, 6 ref.

Descriptors: *Weirs, *Baffles, *Fish passages, Mathematical equations, Slotted-weir baffle, Offset baffle.

An experimental study on the hydraulics of a culvert fishway provided with a relatively simple slotted-weir baffle system was performed. The experiments were performed with six designs involving baffle heights of 0.15 and 0.1 time the diameter (D) of the culvert and longitudinal spacing of 0.6D, 1.2D, and 2.4D. A flow equation was developed to predict the flow depth for any given discharge, diameter, and slope. The barrier velocity that would exist at the slot in the baffles has also been predicted in a general manner. This baffle system has been found to match the performance of the more complicated but frequently used offset baffle system of similar dimensions. (Author's abstract)
W90-01368

**COMPUTER METHODS AND WATER RESOURCES: FIRST INTERNATIONAL CONFERENCE, MOROCCO 1988.**
For primary bibliographic entry see Field 7C.
W90-01409

**TRANSFORMATION OF SURGE WAVES IN A WATER COURSE (TRANSFORMATION D'ONDES DE CRUE DANS UNE RETENUE).**
Gdansk Technical Univ. (Poland). Lab. of Hydraulic Construction.
J. Geringer.
IN: Computer Methods and Water Resources: First International Conference, Morocco, 1988. Vol. 3, Computational Hydrology. Computational Mechanics Publications, Boston. 1988. p 131-156, 4 fig, 1 ref. No English summary.

Descriptors: *Model studies, *Waves, *Hydraulics, *Hydraulic models, *Surges, *Mathematical models, Laboratory equipment.

An experimental method for investigating water management and water course problems was developed. The method uses a 6 x 5.5 m tank provided with a drain system at its bottom and annular outflows. The flow is measured by a limnimeter for the permanent regime and by an electric probe for the transitory regime. Another electrical probe measures the flow as a function of time. A 'close/open' mechanism in the tank permits the expression of the relationship between the hydrograms at the entrance and exit, eliminating the need to investigate the process within the reservoir. The findings were used to derive a mathematical model. (See also W90-01409) (Peters-PTT)
W90-01421

## 8C. Hydraulic Machinery

**HYDRAULICKING AT POWER CONSTRUCTION PROJECTS.**
M. S. Triandafilov, M. M. Kontseropyatov, and I. V. Lipskii.
Hydrotechnical Construction HYCOAR, Vol. 22, No. 11, p 623-626, May 1989. 2 fig, 3 tab. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 11, p 6-8, November 1988.

Descriptors: *Hydraulic structures, *Hydroelectric plants, *Hydroelectric power, *Earthworks, *Hydraulic engineering, *Excavation, Dams, Project planning, USSR, Electrical powerplants, Construction, Soil engineering.

Development of resources in Western Siberia, primarily in oil and gas, have required the expansion of existing electric power stations as well as the construction of new ones. Important aspects of the planning and performance of hydraulic earthworks for conditions of Western Siberia, allowing high efficiency in the fall-winter and early spring periods, are reviewed, including: the making of well-founded decisions on reducing the volume of preparation of foundations of earth structures, including hydraulic structures, and dispensing with removal of peat and other weak soils with an extensive change to hydraulic filling of dams with a flattened profile; hydraulic filling of territories and sites for construction on a frozen foundation with subsequent construction of buildings and structures on pile foundations; efficient organization of the excavation of pits, providing for the preparation and protection of their surface with consideration of processes of freezing and thawing of the soil, arrangement of the dredges at the start of winter, strict sequence of excavating the underwater and above-water faces with consideration of prolonging the season of operations; an increase of inflow into the pit of melted groundwater by increasing the depth of excavation and not allowing the runoff to overland waters into the pit, and equipping of dredges with deep mud intakes (ejectors and submersible pumps), which is especially important under conditions of considerable fluctuation of the water level. (Friedmann-PTT)
W90-01196

**KIAMBERE HYDROELECTRIC PROJECT, KENYA: PART 1. PLANNING AND ECONOMIC STUDIES.**
J. Tattersfield, and P. A. Mawer.
Proceedings of the Institution of Civil Engineers PCIEAT, Vol. 86, No. Part I, p 771-786, August 1989. 5 fig, 5 tab, 10 ref.

Descriptors: *Hydroelectric plants, *Hydroelectric power, *Civil engineering, *Water resources development, Dam design, Tunnel construction, Turbines, Electrical equipment, Design criteria, Construction, Economic aspects, Economic evaluation, Computer models, River systems, Geothermal power, Planning, Kenya.

The Kiambere Hydroelectric Project, commissioned in early 1988, represents an important phase in the development of Kenya's hydroelectric power resources. The main components of the scheme are: the main embankment dam, the tunnel works, an underground powerhouse, and two Francis turbines with associated generators, transformers, switchgear and transmission. The civil engineering aspects, as related to design and installation, of this project made up about 80% of the capital cost. An economic evaluation of various design options favored a downstream development scheme with an underground powerhouse arrangement. A computer model was used to simulate this scheme for further evaluation of its economic benefits. The importance of this scheme in relation to Kenya's power system and to the future development of one of the country's major river systems, coupled with the relative complexity of the operation of the scheme in conjunction with other hydroelectric power, geothermal and fossil-fired generating stations, all called for an especially detailed approach to the planning and evaluation of the project. The outcome of the studies proved entirely satisfactory, both financially in terms of the rates of return and equalizing discount rates, and technically in terms of feasibility and construction programming. The client (the Government of Kenya) was thus able to confidently seek the support of suitable funding sources and at the same time instruct the consultant to proceed with detailed design and tender documentation. (See W90-01355 thru W90-01356) (Fish-PTT)
W90-01354

**KIAMBERE HYDROELECTRIC PROJECT, KENYA: PART 2. DESIGN.**
A. B. Miller, and R. D. Gill.
Proceedings of the Institution of Civil Engineers PCIEAT, Vol. 86, No. Part I, p 787-812, August 1989. 17 fig, 4 tab, 7 ref.

Descriptors: *Hydroelectric plants, *Hydroelectric power, *Water resources development, *Civil engineering, Embankments, Tunnel construction, Dam construction, Turbines, Electrical equipment, Sites, On-site investigations, Geological surveys, Construction, Access routes, Diversion, Spillways, Kenya.

The Kiambere Hydroelectric project, commissioned in early 1988, represents an important phase in the development of Kenya's hydroelectric resources. The main components of the scheme are: the main embankment dam, the tunnel works, an underground powerhouse, and two Francis turbines with associated generators, transformers, switchgear and transmission. The detailed design included selection of the scheme layout, site investigation, geological investigation, preliminary site construction (access roads, camps, etc.), civil works construction (embankment dams, river diversion, spillways, water passages for the power system, underground powerhouse, and control building and services shaft), and mechanical and electrical plant installation and construction (turbines and generators; cranes; switchgear, transformers and transmission; and gates, valves and screens). (See also W90-01354 and W90-01356) (Fish-PTT)
W90-01355

**KIAMBERE HYDROELECTRIC PROJECT, KENYA: PART 3. FINANCE AND CONSTRUCTION.**
J. Tattersfield, and J. C. Bennett.
Proceedings of the Institution of Civil Engineers PCIEAT, Vol. 86, No. Part I, p 813-841, August 1989. 13 fig, 6 tab, 8 ref.

Descriptors: *Hydroelectric power, *Hydroelectric plants, *Water resources development, *Civil engineering, *Financing, Economic aspects, Embankments, Tunnel construction, Dam construction, Turbines, Electrical equipment, Sites, Construction costs, Spillways, Bases, Silica, Budgeting, Contracts, Contracts, Kenya.

The Kiambere hydroelectric project, commissioned in early 1988, represents an important phase in the development of Kenya's hydroelectric resources. The main components of the scheme are: the main embankment dam, the tunnel works, an underground powerhouse, and two Francis turbines with associated generators, transformers, switchgear and transmission. By any standards the Kiambere project represented a massive investment for Kenya. The timing of the project also coincided with a period when Kenya's balance of payments was under threat and there was pressure

to curtail expansion of external borrowing. Despite these problems the project was successfully launched, with remarkable economies being achieved in both construction and financing costs. The civil engineering works were broken down into several small packages, resulting in these contracts having widely differing completion dates. The consultants were given the full responsibility for the overall management of the project site and coordination of the works. The construction was broken down into the main works, embankment dams, spillway, tunnels and shafts, powerhouse cavern, surface structures, alkali-silica reaction research, and mechanical and electrical plant. The scheme has been completed within budget and with commercial generation starting only one month behind the program. Social and environmental aspects that had to be considered were personnel and housing, health and safety, and environmental impact. (See W90-01354 thru W90-01355) (Fish-PTT)
W90-01356

**EXPERIENCES GAINED DURING THE HYDRAULIC INVESTIGATIONS ON THE COOLING WATER SYSTEM OF A THERMAL POWER STATION.**
*Vizgazdalkodasi Tudomanyos Kutato Intezet*, Budapest (Hungary).
For primary bibliographic entry see Field 7B.
W90-01814

## 8D. Soil Mechanics

**POLYMER FILM MATERIALS IN WATERTIGHT MEMBERS OF EARTH STRUCTURES.**
For primary bibliographic entry see Field 8G.
W90-01203

**CRITERIA FOR DAM SAFETY.**
For primary bibliographic entry see Field 8A.
W90-01204

**TECHNOLOGY OF CONSTRUCTING PRECAST ASPHALTIC CONCRETE MEMBRANES OF EARTH DAMS.**
For primary bibliographic entry see Field 8F.
W90-01207

## 8E. Rock Mechanics and Geology

**CONTEMPORARY VERTICAL CRUSTAL MOVEMENTS AT THE SITE OF THE BESTYUBINSK HYDRO DEVELOPMENT.**
A. P. Kartashov, P. A. Ostropiko, and P. A. Artushkevich.
Hydrotechnical Construction HYCOAR, Vol. 22, No. 11, p 664-667, May 1989. 3 fig, 2 tab, 5 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 11, p 38-40, November 1988.

Descriptors: *Hydraulic structures, *Hydroelectric plants, *Tectonics, *Dam effects, *Seismic properties, *Engineering geology, Geologic fractures, Design criteria, Construction methods.

The problem of the safe operation of large hydraulic structures located in seismically active regions is closely related to problems of spatial/temporal investigation of contemporary crustal movements (CCM) of the region of construction. The leading role of the systems approach in the organization of a geodetic network for studying contemporary geokinematics of a construction site is reviewed on the basis of concrete data of geodetic measurements in the region of Bestyubinsk hydro development (U.S.S.R.). Geodynamic investigations at the hydro development began in 1980. Since the earth's crust represents a system with many interrelations and history of development, the geodynamic investigations were preceded by a detailed analysis of the of the geological and seismotectonic structure of the region of the construction site jointly with the data on contemporary vertical crustal movements (CVCM), as obtained from results of repeated high-precision levelings of contiguous sections of the lines of the state vertical control network. THe region of construction of the hydro development was found to be in a zone with activity A = 0.15-0.20. Since the end of the last century, there have been five earthquakes of magnitude M from 5.0 to 8.4. The crust of this region is able to generate earthquakes with energy class K = 15-16 (i.e., energy E = 10 to the 15th to 10 to the 16th power J). Consideration of these geodynamic situations led to the development of a two-level leveling network at the hydro site. The geodetic construction of the second level, the local leveling microcircuit in the region of the dam site, represents an areal leveling network, which makes it possible to represent the results of studying the CVCM in the vicinity of the dam site in the form of a map of the rates of contemporary movement. (Friedmann-PTT)
W90-01205

## 8F. Concrete

**CEMENT-BASED STABILIZATION OF WASTES: PRACTICAL AND THEORETICAL CONSIDERATIONS.**
For primary bibliographic entry see Field 5E.
W90-01080

**EFFECT OF THE STRUCTURE OF ASPHALTIC POLYMER-IMPREGNATED CONCRETE ON ITS FROST RESISTANCE AND WATER IMPERMEABILITY.**
L. I. Dvorkin, V. L. Shestakov, V. G. Ganchikov, and V. N. Marchuk.
*Hydrotechnical Construction HYCOAR*, Vol. 22, No. 11, p 652-655, May 1989. 2 fig, 1 tab. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 11, p 28-30, November 1988.

Descriptors: *Hydraulic structures, *Concretes, *Concrete construction, *Concrete mixes, *Construction materials, *Hydraulic permeability, Cements, Polymers, Hydraulic head.

The main service requirements of watertight facings of hydraulic structures are that they provide water impermeability under the acting heads, water stability under the constant or temporary effect of water, frost resistance, thermal stability, crack resistance, etc. As applied to asphaltic concrete, these requirements are largely transformed into requirements of minimum strength of the material and minimum water absorption under a vacuum. The effect of temperatures and porosity on the deformation and strength properties of asphaltic concrete, modified with a thermoplaster, were studied. The so-called rotatable design on a hexagon was used for the study, where the first factor is varied at five levels and the second at three. The compressive strength and water absorption of the modified asphaltic polymer-impregnated concrete (APC) were determined. It was found that for a porosity of about 5%, the quality indices of APC are at the level of the requirements of the existing specifications P20-85: K sub F > or = 0.85, R sub 20 > 3 MPa, R sub 50 > 1.2 MPa, K sub th > 2.5-3. The APC showed a porosity of 4-5% withstanding water pressure of 0.2-0.3 MPa without its infiltration through specimens. These results show that the traditional requirements should be revised for residual porosity, to not more than 3% of APC-base structural members. (Friedmann-PTT)
W90-01202

**PHYSICAL MODELING OF THE STRESS STATE IN JOINTS OF PRECAST REINFORCED-CONCRETE MEMBERS.**
A. V. Sidorov.
Hydrotechnical Construction HYCOAR, Vol. 22, No. 11, p 668-673, May 1989. 1 fig, 6 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 11, p 41-44, November 1988.

Descriptors: *Hydraulic structures, *Model studies, *Concretes, *Concrete mixes, *Concrete construction, *Construction methods, Hydraulic engineering, Construction materials, Physical properties, Tensile stress.

When constructing large hydraulic structures from precast reinforced concrete it is necessary to solve the problem of creating strong and solid joints of the reinforced-concrete elements. The presence in the joint zone of two concretes differing in age means that their most important properties, namely shrinkage and creep, changing with time, simultaneously change the stress state of the joint, which in turn affects its bearing capacity. The stress state of joints of precast reinforced-concrete hydraulic structures were investigated, with recommendations on modeling the physical processes of the stress state of concrete and reinforcement with the use of models of real structural members for the experimental investigations. The studies included those of the long-acting force in the cross section of the unsealed reinforced-concrete elements, loading or shrinkage, calculated from the start of hardening of the concrete of the precast reinforced-concrete elements and sealing concrete, and the long-acting force acting in cross sections of the ordinary and sealing concrete, calculated in the period up to the start of hardening of the sealing concrete. It is shown that, given the shrinkage strains, the stresses in the concrete and reinforcement can be calculated, leading to calculation of the shrinkage force. It is concluded that experimental investigations of models conducted to study the effect of creep and shrinkage strains on the stress state of joints of precast reinforced concrete should be carried out on the basis of the laws of similarity with the use of dimensionless numbers described in the formulas presented. (Friedmann-PTT)
W90-01206

**TECHNOLOGY OF CONSTRUCTING PRECAST ASPHALTIC CONCRETE MEMBRANES OF EARTH DAMS.**
A. A. Ravkin, and S. V. Gavrilov.
Hydrotechnical Construction HYCOAR, Vol. 22, No. 11, p 674-676, May 1989. 1 fig, 3 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 11, p 45-47, November 1988.

Descriptors: *Asphaltic concrete, *Concrete mixes, *Construction materials, *Dam construction, *Dams, Hydraulic structures, Rockfill dams, Concretes, Construction.

In recent years, asphaltic concrete membranes (ACM) have been used as the main watertight element when designing rockfill dams. The current technology of constructing the precast ACM is reviewed, and includes the manufacture of the precast asphaltic concrete elements of the membrane under plant or casting yard conditions. A new method of sealing a precast ACM is presented. The asphaltic concrete membrane of an earth dam is constructed from precast blocks. Before installing a block, the place on the surface of the underlying course on which that block is to be installed is heated to melting of the 'solder' placed on it beforehand. Asphaltic mastic in the form of thin slabs or plates made at the same plant or casting yard where the precast blocks are manufactured serves as the 'solder.' Thermal radiators heat and melt the solder. When the solder melts, the block is brought directly to the place of installation, the mobile frame is rolled away, and the block is at once lowered onto the melted solder, and not allowed to cool. The advantages of this method are independence from weather and climatic conditions of the construction site, and a combined and reliable solution to the problem of sealing horizontal and vertical joints. (Friedmann-PTT)
W90-01207

**SPECIAL HIGH GRADE UNDERWATER CONCRETE (IN JAPANESE).**
M. Sakamoto, and T. Hatsuzaki.
In: Taisei Technical Research Report 20. p 115-125, 19 fig, 10 tab. English summary.

Descriptors: *Concretes, *Concrete technology, *Concrete testing, *Underwater concrete, Pollution, Leveling, Strength, Temperature, Heat of hydration.

Special high grade underwater concrete should have the following properties: (1) No segregation when dropped into water; (2) No pollution (no alkali or cement comes out into surrounding matter); (3) Self leveling; and (4) Little deviation in the strength of hardened concrete; The concrete obtained which contains an admixture of soluble polymer was named Taisei Self Leveling Concrete (TSL Concrete). The results of three types of experiments were: (1) Fundamental experiment of mortar: TSL mortar which contains the admixture of soluble polymer (sold by the name of USCA) showed much better properties than the one without the admixture in segregation, workability and strength of mortar placed in water after hardening: (2) Fundamental experiment of concrete: Designed slumpflow and strength were 50 (+ or -) 2.5 cm and 210 kgf/sq cm, respectively. The contents of the admixture were 0, 2.0, 2.5 and 3.0 kg/cu m. The more the quantity of the admixture, the less turbidity and the higher strength ratio of hardened concrete placed in water and air: and (3) Fundmental experiment of concrete for mass concrete: When a kind of heat of hydration restraining admixture (CSA 200 s) was employed, temperature increase was restrained about 1/5 at most. (Author's abstract)
W90-01735

**INVESTIGATION OF CONCRETE GRID PAVEMENTS.**
Virginia Polytechnic Inst. and State Univ., Blacksburg. Coll. of Architecture and Urban Studies.
G. E. Day.
IN: Stormwater Management Alternatives. Water Resources Center, University of Delaware, Newark, DE. April 1980. p 45-63. 10 fig, 2 tab, 19 ref.

Descriptors: *Water pollution control, *Storm water management, *Urban hydrology, *Paving, *Storm runoff, *Concrete technology, Concretes, Runoff coefficient, Hydraulic conductivity, Urban planning.

Five pavements exhibiting different physical characteristics were subjected to rainfall in order to collect runoff data. Testing apparatus contained three major elements: the rain simulator, the testing bins and the water collection system. The five pavements included: Grasstone from Boiardi Products, Turfblock from Paver Systems, Inc., Wausau Tile, Grasscrete from Bomanite Corp., Monoslab from Grass Pavers, Ltd, and Checker Block from Hastings Co. Coefficients of runoff and lag times were derived based on the following variables: (1) subgrade soil, (2) slope, (3) rainfall intensity, and (4) rainfall duration. The ability of the paver to absorb and detain rainwater tended to be a function of its surface geometry, not the percent of bottom open area. An increase in slope (up to 7%) increased the coefficient of runoff regardless of paver type, subsoil type, or rainfall intensity. And subsoil type, as expressed by hydraulic conductivity, had an effect on the coefficient of runoff. Tentative runoff coefficients can provide the basis for design and implementation of the pavements as an alternative on-site technology within an overall stormwater management scheme. (See also W90-01919) (Mertz-PTT)
W90-01924

**POROUS PAVING.**
L. R. Howe.
IN: Stormwater Management Alternatives. Water Resources Center, University of Delaware, Newark, DE. April 1980. p 65-67.

Descriptors: *Water pollution control, *Storm water management, *Urban hydrology, *Concrete technology, *Paving, *Storm runoff, *Asphalt, Urban planning, Detention reservoirs, Permeability.

The concept of porous pavement is to allow rain water to penetrate through a porous asphalt surface into a crushed stone base course reservoir which temporarily stores the water. The stored water is then absorbed by the soil and returned to the water table. This is expressed by the simple hydrologic relationship: Inflow minus Outflow equals Storage. The total design thickness must be chosen in light of each of the following factors: soil support, frost penetration, traffic load, (as in conventional paving) and the reservoir capacity to meet the requirements for stormwater management. The criteria for estimating the reservoir for capacity are: soil permeability, maximum storm intensity and frequency, allowable runoff, and slope. Problems with porous pavement include: superficial dirt will not plug the pavement but dirt and leaves cannot be allowed to accumulate on the surface and be ground in by traffic or it will close pores; very heavy traffic can break down the surface and close pores; and in areas of concentrated traffic at parking lot toll gates, the power steering of wheels in a stationary position will rupture the porous surface. (See also W90-01919) (Mertz-PTT)
W90-01925

## 8G. Materials

**POLYMER FILM MATERIALS IN WATERTIGHT MEMBERS OF EARTH STRUCTURES.**
V. P. Lysenko, and A. I. Belyshev.
Hydrotechnical Construction HYCOAR, Vol. 22, No. 11, p 655-658, May 1989. 1 tab, 5 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 11, p 30-33, November 1988.

Descriptors: *Polymers, *Rubber, *Construction materials, *Physical properties, *Earthworks, *Hydraulic permeability, Temperature effects, Water boundaries.

The history of the use and effectiveness of polymer film materials in watertight film members, including plasticized polyvinyl chloride, polyethylene, and butyl rubber, are reviewed. These materials have high deformation characteristics, having elongation breaking points of hundreds percent. The film thickness is usually 0.2-2.0 mm. Their ever-increasing use is due mainly to three reasons: they meet the required physical and mechanical characteristics, the make possible the creation of watertight members practically completely impermeable for water and its solutes, and the high rate of construction, reaching several hectares of covering per day, and low unit consumption of the materials. This small unit materials consumption of polymer, particularly polyethylene, as well as their watertight qualities and high potential productivity at almost any ambient air temperature allow predetermination of their effectiveness in year-round construction regardless of the climatic region and area of the object being faced. An urgent problem is the development of specifications and setting up of the production of polymer materials intended specifically for creating watertight elements of earth structures. Such materials can be polyethylene panels with a thickness of 0.5-1.0 mm with protective layers such as foamed polyethylene with a thickness of 5-10 mm, applied on one or two sides. (Friedmann-PTT)
W90-01203

**PHYSICAL MODELING OF THE STRESS STATE IN JOINTS OF PRECAST REINFORCED-CONCRETE MEMBERS.**
For primary bibliographic entry see Field 8F.
W90-01206

**SEALING DEVICE FOR WIDE EXPANSION JOINTS.**
G. V. Shtyrov.
Hydrotechnical Construction HYCOAR, Vol. 22, No. 11, p 677-678, May 1989. 1 fig, 3 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 11, p 47, November 1988.

Descriptors: *Construction materials, *Hydraulic structures, *Seepage control, *Sealants, *Impervious membranes, Polymers, Rubber, Construction methods.

A sealing device design is developed for expansion of joints of high-head hydraulic structures, consisting of a sealing membrane which obviates the unreliability of the work of shaft waterbars of wide expansion joints is The watertight elastic membrane is pressed by the seepage pressure of water against the concrete surface of one section of the hydraulic structure and against the netting. This netting absorbs the seepage pressure of the water being transferred by the elastic membrane, and thus acts as a seal in the device. The netting makes it possible to cover expansion-settlement joints by means of rubber or polymer membranes of any required width. Also, the device makes it possible to use less strong, but more elastic membranes made from comparatively cheap rubber or polymer. (Friedmann-PTT)
W90-01208

## 8H. Rapid Excavation

**SEVERAL PROBLEMS OF DAM CONSTRUCTION BY DIRECTIONAL BLASTING.**
Institute of Water Conservancy and Hydroelectric Power Research, Beijing (China).
Y. Huo.
Available from the National Technical Information Service, Springfield, VA 22161, PB89-112726. Price codes: E03 in paper copy, A01 in microfiche. ISTIC Technical Report No. TR-C 000141, 1987. 8p, 3 fig, 2 tab, 6 ref.

Descriptors: *Explosions, *Directional blasting, *Rapid excavation, *Dam construction, *China, *Excavation, Dams, Cofferdams, Tunnels, Project planning, Rock excavation.

In China dam construction by directional blasting method started in 1958. Until now a lot of dams have been completed for various developmental purposes, such as storage dam, mudflow protection dams, tailings storage dam, fly-ash storage dam, cofferdam, etc. According to the practical experience of building dams by directional blasting in China, the study of the following problems is of great importance: planning and arrangement of charges; effects on tunnel due to explosion and its safety criterion; problems of vibration due to blasting in rock; and the deformation characteristics of dams. (Lantz-PTT)
W90-01720

## 8I. Fisheries Engineering

**EFFECTS OF PLACER MINING DISCHARGE ON HEALTH AND FOOD OF ARCTIC GRAYLING.**
Alaska Cooperative Fishery Research Unit, Fairbanks.
For primary bibliographic entry see Field 5C.
W90-00978

**WATER QUALITY CONDITIONS AND PARTICULATE CHLOROPHYLL A OF NEW INTENSIVE SEAWATER FISHPONDS IN EILAT, ISRAEL: DAILY AND DIEL VARIATIONS.**
Israel Oceanographic and Limnological Research Ltd., Haifa.
A. Neori, M. D. Krom, I. Cohen, and H. Gordin.
Aquaculture AQCLAL, Vol. 80, No. 1-2, p 63-78, August 1989. 8 fig, 26 ref. Joint German-Israeli Research Program, project no. GR/305-AQ 7 III, BARD research grant no. I-626-83.

Descriptors: *Aquaculture, *Fish ponds, *Water quality, *Chlorophyll a, Dissolved oxygen, Hydrogen ion concentration, Nutrients, Ammonia, Nitrogen, Phosphorus, Phytoplankton, Fish, Diel variation, Israel, Eutrophication.

Water quality parameters were studied in new, intensive, intermediate-flow, marine fishponds in Eilat, Israel. The 100 cu m ponds have a hard wall and differ from the earthen ponds studied here formerly in the continuous water aeration and stirring. This feature concentrates the organic detritus in the center to be flushed out daily, thus reducing the organic load in the pond. Dissolved oxygen, inorganic and organic nutrients, pH and particulate chlorophyll a concentrations were measured daily, and occasionally every 3-4 h over a 30-h period, during May 1987. The results showed 2-3 'bloom-and-crash' cycles of chlorophyll concentration in

each of the two ponds observed. The concentrations of ammonia-N and inorganic P showed an inverse correlation with those of chlorophyll a whereas pH and dissolved oxygen levels showed daily changes whose magnitudes were proportional to chlorophyll a concentration. The large fluctuations in chlorophyll magnitudes were found by epifluorescence microscopy to be related to microflagellate grazing of the phototrophic algae. Fish ammonia excretion and algal ammonia-N uptake accounted for most variations in water quality criteria, with only minor benthic contribution. Usually, chlorophyll a concentrations in the pond were medium to high, and the diel variation in water quality was phytoplankton-dominated. Only during times of low chlorophyll a concentrations was diel variation in water quality determined predominantly by fish metabolism. Water quality deteriorated significantly only during the maxima and minima of he phytoplankton bloom-and-crash cycles. In intermediate-flow ponds, temporary reduction of feeding is suggested as an effective water quality control measure. It should be used at the onset of both a bloom and a crash, in preference to increased water exchange. (Author's abstract)
W90-01011

**CARBON DIOXIDE EQUILIBRIA AND NUTRIENT AVAILABILITY IN TWO CULTURE PONDS AT NARAKKAL DURING THREE MONSOON AND POST-MONSOON MONTHS, JUNE-SEPTEMBER, 1984.**
Central Marine Fisheries Research Inst., Cochin (India).
For primary bibliographic entry see Field 2H.
W90-01286

**NUVAN USE IN SALMON FARMING: THE ANTITHESIS OF THE PRECAUTIONARY PRINCIPLE.**
Marine Conservation Society, Ross-on-Wye (England).
A. Ross.
Marine Pollution Bulletin MPNBAZ, Vol. 20, No. 8, p 372-374, August 1989. 19 ref.

Descriptors: *Organophosphorus pesticides, *Nuvan, *Toxicity, *Water pollution sources, *Fish farming, *Salmon, Governmental control, Legislation.

Nuvan 500 EC is an organophosphorus pesticide (active ingredient: dichlorvos) which has been used in the salmon farming industry to control sea lice. Recent investigations have suggested that, given Nuvan's known toxicity and the extensive gaps in our knowledge about its environmental effects, the widespread and growing use of this substance in the marine environment is unacceptable. The current controls of the use of Nuvan are inadequate and largely contrary to the United Kingdom government's stated committment to a precautionary approach to marine pollution. (Author's abstract)
W90-01328

**SELF-POLLUTION BY SCOTTISH SALMON FARMS.**
Nature Conservancy Council, Peterborough (England).
C. M. Lumb.
Marine Pollution Bulletin MPNBAZ, Vol. 20, No. 8, p 375-379, August 1989. 4 fig, 1 tab, 8 ref.

Descriptors: *Water pollution sources, *Fish farming, *Salmon, *Organic loading, Self-pollution, Scotland.

A study of 57 salmon farms in Scotland has shown that acute organic enrichment, usually accompanied by sediment outgassing, occurred beneath most cages. Development of these conditions is considered likely to result in 'self-pollution' of the fish farm. A relationship between the seabed type, water depth, water movement, and the intensity of organic enrichment was observed. Site selection guidelines are suggested for reducing the risk of self-pollution and these are compared with those used by the fish farm industry elsewhere. The long seabed recovery time found at sheltered sites emphasizes the importance of site selection and also indicates that some site management practices may need modifying. (Author's abstract)
W90-01329

**ENVIRONMENTAL MONITORING OF CAGED FISH FARMING IN MACROTIDAL ENVIRONMENTS.**
Fisheries Studies Council, Pembroke (Wales). Oil Pollution Research Unit.
C. L. J. Frid, and T. S. Mercer.
Marine Pollution Bulletin MPNBAZ, Vol. 20, No. 8, p 379-383, August 1989. 3 fig, 1 tab, 13 ref.

Descriptors: *Monitoring, *Fish farming, *Tidal effects, *Environmental protection, *Farm wastes, Eutrophication.

Recent years have seen considerable expansion in fish farming using sea cages. These have until recently been located in the sheltered and low current environments of sea lochs and fjords. Significant benthic enrichment is known to occur at these sites, but the effect is highly localized. Fish farm development is now occurring in areas with strong tidal flows. The siting of caged fish farming in macrotidal environments may reduce the environmental impact of the industry on benthic communities at the farm site. However, there exists the potential for accumulation of farm wastes in nearby sedimentary sinks. Additionally, the longer residence time of the wastes in the water column has the potential, especially in regions with already high nutrient loadings and/or long flushing times, to lead to stimulation of phytoplankton blooms. Environmental monitoring of such developments therefore needs to consider these additional effects. (Author's abstract)
W90-01330

**USE OF REMOTS TECHNOLOGY IN MONITORING COASTAL ENRICHMENT RESULTING FROM MARICULTURE.**
University Coll., Galway (Ireland). Dept. of Zoology.
For primary bibliographic entry see Field 7B.
W90-01331

**HYDRAULIC GEOMETRY OF STREAMS AND STREAM HABITAT ASSESSMENT.**
Illinois State Water Survey Div., Champaign. Surface Water Section.
For primary bibliographic entry see Field 2E.
W90-01345

**HYDRAULICS OF CULVERT FISHWAYS II: SLOTTED-WEIR CULVERT FISHWAYS.**
Alberta Univ., Edmonton. Dept. of Civil Engineering.
For primary bibliographic entry see Field 8B.
W90-01368

# 10. SCIENTIFIC AND TECHNICAL INFORMATION

## 10D. Specialized Information Center Services

**NATIONAL WATER-INFORMATION CLEARINGHOUSE ACTIVITIES: GROUND-WATER PERSPECTIVE.**
Geological Survey, Reston, VA. Water Resources Scientific Information Center.
C. A. Haupt, and R. A. Jensen.
USGS Open-File Report 88-114, 1988. 2p, 2 fig.

Descriptors: *Information exchange, *National Water-Information Clearinghouse, *Groundwater, Institutions, Water resources institutes, Data storage and retrieval, Data collections.

The US Geological Survey (USGS) has functioned for many years as an informal clearinghouse for water resources information, enabling users to access groundwater information effectively. Water resources clearinghouse activities of the USGS are conducted through several separate computerized water information programs that are involved in the collection, storage, retrieval, and distribution of different types of water information. The following USGS programs perform water information clearinghouse functions and provide the framework for a formalized National Water-Information Clearinghouse: (1) The National Water Data Exchange--a nationwide confederation of more than 300 Federal, State, local, government, academic, and private water-oriented organizations that work together to improve access to water data; (2) the Water Resources Scientific Information Center--acquires, abstracts, and indexes the major water-resources-related literature of the world, and provides this information to the water resources community; (3) the Information Transfer Program--develops innovative approaches to transfer information and technology developed within the USGS to audiences in the public and private sectors; (4) the Hydrologic Information Unit--provides responses to a variety of requests, both technical and lay-oriented, for water resources information, and helps efforts to conduct water resources research; (5) the Water Data Storage and Retrieval System--maintains accessible computerized files of hydrologic data collected nationwide, by the USGS and other governmental agencies, from stream gaging stations, groundwater observation wells, and surface- and groundwater quality sampling sites; (6) the Office of Water Data Coordination--coordinate the water data acquisition activities of all agencies of the Federal Government, and is responsible for the planning, design, and inter-agency coordination of a national water data and information network; and (7) the Water Resources Research Institute Program--coordinates and evaluates activities performed by a variety of groundwater contamination studies ranging from field investigations to analysis of socioeconomic issues. (Lantz-PTT)
W90-01778

**WATER RESOURCES SCIENTIFIC INFORMATION CENTER.**
Geological Survey, Reston, VA. Water Resources Scientific Information Center.
C. W. Cardin, and J. T. Campbell.
USGS Open-File Report 86-303, 1986. 2p, 2 fig.

Descriptors: *Information exchange, *Water Resources Scientific Information Center, *Abstracts, Bibliographies, Reviews, Indexes, Documentation, Data collections.

The Water Resources Scientific Information Center (WRSIC) acquires, abstracts and indexes the major water resources related literature of the world, and makes information available to the water resources community and the public. A component of the Water Resources Division of the US Geological Survey, the Center maintains a searchable computerized bibliographic data base, and publishers a monthly journal of abstracts. Through its services, the Center is able to provide reliable scientific and technical information about the most recent water resources developments, as well as long-term trends and changes. WRSIC was established in 1966 by the Secretary of the Interior to further the objectives of the Water Resources Research Act of 1964--legislation that encouraged research in water resources and the prevention of needless duplication of research efforts. It was determined the WRSIC should be the national center for information on water resources, covering research reports, scientific journals, and other water resources literature of the world. WRSIC would evaluate all water resources literature, catalog selected articles, and make the information available in publications or by computer access. In this way WRSIC would increase the availability and awareness of water related scientific and technical information. (Lantz-PTT)
W90-01779

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Precariousness or even the Lack of Recharge of the Phreatic Aquifer in the North Sahelian Area of Chad during the last 26 Years (La precarite ou meme l'absence d'alimentation de la nappe phreatique en zone nord-sahelienne du Tchad. Resultats d'un quart de siecle de surveillance piezometrique).
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**CENTERS FOR DISEASE CONTROL, ATLANTA, GA.**
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**CENTRAL GROUND WATER BOARD, BHOPAL (INDIA).**
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**CENTRAL MARINE FISHERIES RESEARCH INST., COCHIN (INDIA).**
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**CENTRE DE RECHERCHES DE RENNES (FRANCE).**
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**CENTRE FOR WATER RESOURCES DEVELOPMENT AND MANAGEMENT, CALICUT (INDIA).**
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**CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE, TOULOUSE (FRANCE). INST. DE MECANIQUE DES FLUIDES.**
Practical Comparison of Flood Forecast Methods. Example of the Aveyron River (Comparaison Pratique de Methodes de Prevision de Crue. Exemple de l'Aveyron).
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**CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE, VANDOEUVRE-LES-NANCY (FRANCE). EQUIPE DE RECHERCHE SUR LA COAGULATION-FLOCULATION.**
Aluminum and Iron(III) Chemistry: Some Implications for Organic Substance Removal.
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Examinations on a Resin's Capacity of Adsorption for Phenolic Compounds in Waters (1st Communication) (Untersuchungen zur Adsorptionsfahigkeit eines Harzes an Phenolischen Verbindungen in Wassern (1. Mitt.)).
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Lethal and Sublethal Toxicity of 4-Nonylphenol to the Common Mussel (Mytilus edulis L).
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Computerization of the Bachet Method (Informatisation de la Methode Bachet).
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Water Balance Techniques Applied to Industrial Complexes.
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Rainfall Trends in West Africa, 1901-1985.
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Snow Cover as an Indicator of Climate Change.
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Epilithic Algal Communities from River Segura Basin, Southeastern Spain.
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Environmental Factors Favouring the Formation of Microcystis aeruginosa Hyperscums in a Hypertrophic Lake.
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Isolation of Toxins from Natural Blue-green Algae and Unicellular Cultured Microcystis Aeruginosa.
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Snow Cover Area (SCA) is the Main Factor in Forecasting Snowmelt Runoff from Major River Basins.
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Improvement of Ultrasonic Flowmeter in Rivers in Japan.
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**NATIONAL RESEARCH COUNCIL OF CANADA, OTTAWA (ONTARIO). DIV. OF CHEMISTRY.**
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Operational Airborne Measurements of Snow Water Equivalent and Soil Moisture Using Terrestrial Gamma Radiation in the United States.
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Self-Pollution by Scottish Salmon Farms.
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Early Smelter Sites: A Neglected Chapter in the History and Geography of Acid Rain in the United States.
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Effects of the Length of Record on Estimates of Annual and Seasonal Precipitation.
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Drainage Reconsidered: The Evolving Role of Public Agencies In Drainage--New Castle County, Delaware.
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Distribution and Role of Bacterial Nitrifying Populations in Nitrogen Removal in Aquatic Treatment Systems.
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Separate and Combined Sewers--Experience in France and Australia.
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Infiltration and Ponding.
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**NEW YORK STATE DEPT. OF HEALTH, ALBANY. WADSWORTH CENTER FOR LABS. AND RESEARCH.**
Anaerobic Biodegradation of Polychlorinated Biphenyls in Hudson River Sediments and Dredged Sediments in Clay Encapsulation.
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Effects of Urbanization on Water Resources in the Waterford River Basin.
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**NIEDERSAECHSISCHES LANDESAMT FUER WASSERWIRTSCHAFT, HILDESHEIM (GERMANY, F.R.).**
Management of Available Water Resources as a Basis for Pollution Control and Rational Use.
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Effect of Urbanization on a Shallow Quaternary Aquifer.
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**UNIVERSIDADE ESTADUAL DE CAMPINAS (BRAZIL). INST. DE QUIMICA.**
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**UNIVERSIDADE FEDERAL DA PARAIBA, CAMPINA GRANDE (BRAZIL). DEPT. OF CIVIL ENGINEERING.**
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**UNIVERSITA DI REGGIO CALABRIA, COSENZA (ITALY).**
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## Subject Fields

1 NATURE OF WATER

2 WATER CYCLE

3 WATER SUPPLY AUGMENTATION AND CONSERVATION

4 WATER QUANTITY MANAGEMENT AND CONTROL

5 WATER QUALITY MANAGEMENT AND PROTECTION

6 WATER RESOURCES PLANNING

7 RESOURCES DATA

8 ENGINEERING WORKS

9 MANPOWER, GRANTS, AND FACILITIES

10 SCIENTIFIC AND TECHNICAL INFORMATION

## INDEXES

SUBJECT INDEX

AUTHOR INDEX

ORGANIZATIONAL INDEX

ACCESSSION NUMBER INDEX

**1990 Price Schedules for the United States, Canada, and Mexico**

These prices are for customers in the United States, Canada, and Mexico; other customers, write for price list PR-360-4.

**Microfiche & Paper Copy Reports**

| *Standard Prices* | | *Exception Prices* | |
|---|---|---|---|
| A01 | $8.00 | E01 | $10.00 |
| A02 | 11.00 | E02 | 12.00 |
| A03 | 15.00 | E03 | 14.00 |
| A04–A05 | 17.00 | E04 | 16.50 |
| A06–A09 | 23.00 | E05 | 18.50 |
| A10–A13 | 31.00 | E06 | 21.50 |
| A14–A17 | 39.00 | E07 | 24.00 |
| A18–A21 | 45.00 | E08 | 27.00 |
| A22–A25 | 53.00 | E09 | 29.50 |
| A99 | * | E10 | 32.50 |
| | | E11 | 35.00 |
| *"N" Codes* | | E12 | 38.50 |
| | | E13 | 41.00 |
| N01 | $60.00 | E14 | 45.00 |
| N02 | 59.00 | E15 | 48.50 |
| N03 | 20.00 | E16 | 53.00 |
| | | E17 | 57.50 |
| | | E18 | 62.00 |
| | | E19 | 69.00 |
| | | E20 | 80.00 |
| | | E99 | * |

**Computer Products**

| *Diskettes* | | *Magnetic Tapes* | |
|---|---|---|---|
| D01 | $50 | T01 | $165 |
| D02 | 80 | T02 | 220 |
| D03 | 130 | T03 | 340 |
| D04 | 180 | T04 | 450 |
| D05 | 230 | T05 | 560 |
| D06 | 280 | T06 | 670 |
| D07 | 330 | T07 | 780 |
| D08 | 380 | T08 | 890 |
| D09 | 430 | T09 | 1,000 |
| D10 | 480 | T10 | 1,110 |
| D11 | 530 | T11 | 1,220 |
| D12 | 580 | T12 | 1,330 |
| D13 | 630 | T13 | 1,440 |
| D14 | 680 | T14 | 1,550 |
| D15 | 730 | T15 | 1,660 |
| D16 | 780 | T16 | 1,770 |
| D17 | 830 | T17 | 1,880 |
| D18 | 880 | T18 | 1,990 |
| D19 | 930 | T19 | 2,100 |
| D99 | * | T99 | * |

* Contact NTIS for price

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